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A WINTER WEED.

BY GRANT ALLEN.

A DAY or two of warm weather, wafted to us by the westerly breezes, has brought out the daisies on the lawn as vigorously as if it were May, instead of January. The sward is dappled all over with their little timid white blossoms in a way that quite defies the decencies of the season. The fact is, modest and shrinking as they seem to be, daisies are very hardy and hard-working small plants, which never miss an opportunity of pushing their way in the world; and no doubt they have their reward, for probably no other flowering kind, except, perhaps, one or two grasses, have been half so successful in colonising the fields and hill-sides as these unobtrusive, wee things have been. In the spring, they are the very earliest plants to bloom; and since the early flower catches the bee, they begin setting their seed before the other blossoms are well awake; all through the summer and autumn they go on blooming uninterruptedly; and even when winter comes, they are ready at a moment's notice to take advantage of any brief gleam of sunlight which may happen to occur, putting forth their pretty buds fearlessly, and alluring the last stray insects of the season to visit their tiny golden bells.

Here in my hand I have grubbed up one entire daisy-plant, root and all, with my cane; and when one comes to look closely at its structure, the secret of its success in life is not difficult to decipher. In the first place, there are the leaves. These we seldom notice when we are examining a daisy, because they are so very retiring and unobtrusive. They lie flat upon the ground, in a small, round, spreading rosette, pressed as tightly as possible against the soil beneath. That is one of the tricks by means of which the daisy secures itself a place in the world. It grows generally in open pastures and commons covered with grass; and as the grass tends always to raise its tall blades as high as possible, the daisy might easily be overshadowed by that powerful competitor. Now, there are two ways in which different plants living in such circumstances can avoid being elbowed out of existence. One way is by sending up taller and bigger leaves than the grasses, so as to intercept the air and sunlight; and this is the plan adopted by such weeds as dock, burdock, coltsfoot, and some plantains. As a rule, however, such tactics can only be followed by plants which possess a reserve fund of food-stuffs laid by in their roots or stocks, for otherwise the young leaves would be choked and starved before they could grow high enough to overtop the competing grasses. Or, to put it more definitely, those kinds alone have succeeded in this way which happened to develope both large leaves and rich reserves of starch at one and the same time. The second plan is that followed by the daisy, the hoary plantain, and many other field-weeds. These plants have learnt to press their foliage closely down in a little circle upon the ground, so as to prevent any grasses from growing up around them and intercepting the sun and air. In other words, such individuals among them as happened to display this tendency, in a slight degree, survived the best; and among their descendants, such as carried it out further and further, spread most afield, while such as fell short of the desired quality, got killed off young by neighbouring weeds. Thus, at last, the daisy acquired its present successful habit of growing close to the ground, and so checking competition in the bud, or rather in the very seedling.

But why, it may be objected, do not all other plants do the same? The answer is, because all are not adapted for the same sort of life as the daisy. One kind survives in virtue of one point of vantage, another kind survives in virtue of another. The English meadow plantains are three closely-allied types of weed, hardly differing from one another in any essential point; yet each of them has solved this problem of foliage in a separate way. The great plantain sends up big, broad leaves on longish stalks, something like those of garden lettuce, which overtop most of its neighbours; the hoary plantain spreads a little tuft close to the earth, like the daisy; and the ribwort plantain meets the grasses on their own ground, by reducing its leaves to mere long, thin, lance-like blades. In each case, the explanation must be accepted on its own merits, without prejudice to different explanations elsewhere. The forms of leaves, indeed, are among the most difficult problems of botany, and it must not be supposed that we can account for them all at once by a single simple and easy formula. One might as well ask why the rabbit is not as big as the red deer, or why the fox is smaller than the lion. Each fills its own niche in nature; so each has been developed into exact correspondence with that particular niche and no other. And different means often subserve exactly the same end. The fleetness of the hare is produced by quite other adaptations than the fleetness of the stag; the foliage of the daisy succeeds by being compact and rounded, the foliage of the buttercup by being cut up into numerous small divergent segments. In short, whatever accidental habit happens to give a plant or animal any advantage in the struggle for existence is perpetuated in its descendants, and gradually perfected by natural selection, and thus the most diverse means often lead up in the long run to the same end.

The reason why the daisy is able to send up buds and blossoms at a moment's notice seems equally clear. The buds are always lying by in readiness close to the little perennial tufted stock. I cut it down the middle with my pocket-knife, and see, in the centre of the tuft, there are two or three unopened flower-buds even now lurking unseen and waiting for their turn to appear. Practically speaking, the daisy is an evergreen, for it always has green leaves upon it all the year round; and these green leaves are perpetually engaged, summer and winter, in manufacturing starch from the carbonic acid of the air, which starch is at once laid by in the root-stock to feed

the young flowers when they are ready to sprout. So the moment a little warm weather arrives, the bud begins to start into life, and is supplied with food from the starch laid by in the root, as well as from the constant gains of the ever-busy leaves. All annual plants have to grow from the seed in a single season, and they have to produce a large number of leaves before they have digested food enough in these their expanded stomachs to feed the future flowers and seed; so that they cannot begin blossoming till comparatively late in the season. But the daisy, being a perennial, with slightly starchy root and practically persistent foliage, gets the start of them from the beginning, so as to put forth its flowers at the earliest possible moment.

And now let me look briefly at this flower itself. It is made up, as everybody knows, of two parts. The centre or disk is yellow, while the outer rays are white. But if one pulls it to pieces, one sees that the disk is really composed of many separate little golden bells, each one something like a harebell on a very small scale. The daisy head, in fact, is not one flower, but a whole lot of distinct flowers crowded together into a single truss. Taking one of the little central yellow bells in detail, I find that its petals are not separate, as in the buttercup, but are all united together into a long tube. The ancestors of the daisy had doubtless ages ago five distinct petals, like those of the buttercup; but at some time or other these petals showed a tendency to coalesce, and as this tendency proved useful to the plant, by more certainly securing its fertilisation by insects, it rapidly grew through survival of the fittest into a fixed habit, not only of the daisy, but of all the great group of flowers to which it belongs. The reason why the tubular shape is more useful than the arrangement with five spreading petals becomes clear enough if we recollect that the insect has to thrust his proboscis down to the bottom of the tube, past the pollen-bearing stamens and the sensitive pistil, in order to reach the tiny drop of honey concealed within. In doing so, a little of the pollen naturally adheres to his proboscis, and is then brushed off against the sensitive surface of the next blossom which he visits, so as thus to impregnate and fertilise its seed. To this day, however, the daisy still retains a reminiscence of the distant period when it possessed five separate petals; for each of the central florets has a vandyked edge of five points, these points being the last representatives of the original distinct flower leaves in its remote progenitors.

The tubular arrangement is common to many flowers besides the daisy family; but the daisies and their allies have carried their development one step further than the rest, for they have learnt to collect several tiny blossoms together into a single compact head, and thus to bid for the attention of insects far more powerfully than they could do in single display. More than that, in the daisy itself, and one or two others of its near relations, the outer florets of each head have become flattened into long ornamental rays, so as to play the part of petals to the compound group. In this way they make the little bunch very noticeable to all passing insects. The ray florets, when closely examined, look like tubes split down one side and opened out, so as to produce as much show as possible. They are the attractive part of the flower-head, and they do little active work themselves, having no stamens and no pollen, but laying themselves out mainly to look pretty alone. For this purpose they are coloured white, with pinky tips, instead of being yellow, like the central florets. Yet, of course, the whole plant is ultimately benefited by this arrangement, because the insects are thus induced to visit the entire little colony at once, and by carrying pollen from one floret to another, to fertilise the whole row of yellow bells then open. For if you look intently into a daisy, you will see that it does not open all over at the same time, but begins opening from the edge, and gradually proceeds towards the centre; so that in most daisies you will find a row or two of over-blown florets outside, a row just open or opening half-way through, and a lot of unopened little buds in the very middle. Doubtless, this arrangement also conduces to the good of the plant, by ensuring the highest and best sort of cross-fertilisation—that which is obtained by impregnating the blossoms of one individual with pollen brought from those of another.

PRECESSION OF THE EQUINOXES.

By the Editor.

THE precession of the equinoxes is, properly speaking, the observed motion of the points on the earth's orbit, where she is when the sun passes from north to south, or from south to north of the celestial equator, these points moving always in a direction contrary to that in which the earth circles round her orbit, so that they travel backwards. As precession really means going forwards, it may seem a little strange that this travelling backwards of the equinoctial points should have received such a name. But, as a matter of fact, the motion of these points (which are those where spring and autumn begin) in a direction opposite to that of the earth's motion, causes them as it were to meet the earth, shortening the time she takes in reaching them, so that the beginnings of spring and autumn *precede* the epochs at which otherwise they would have occurred.

But usually the term "precession" is understood to include all the circumstances on which the observed change depends, and writers will often speak of the precessional reeling of the earth. The reeling itself is, of course, not precessional, it is but the cause of precession.

The change in the position of the points where spring and autumn begin was first discovered by Hipparchus, though Ptolemy usually gets the credit of it. It was found that the point of the ecliptic where the sun is when spring begins—we may say when the year of seasons begins—is slowly moving backwards among the zodiacal constellations. It was once in Taurus, which was spoken of even by Virgil (long after the relation had ceased to exist) as opening the year with its golden horns. Then it passed to Aries, thence to Pisces, in which constellation it is now.

The effects thus produced in the position of the celestial equator, poles, &c., will occupy us hereafter. For the present we wish to consider their cause, or, rather, first we wish to describe what is the actual motion of the earth to which they are due, the real cause of precession being the forces which cause the earth to move in the particular manner in question.

Let us for the moment leave out of account the motion of the earth round her axis, and regarding her centre as at rest, let us consider what is the real nature of that motion of hers which causes precession.

Observation shows that the plane of the ecliptic, in which the earth travels, is almost unchanging in position. The course among the stars along which the sun (if we could see the stars when he is shining) would appear to travel, is almost exactly the same now as it was in the time of Hipparchus. Again, the inclination of the earth's polar axis to the plane in which she travels varies very slightly (the variation shall presently be described, and its physical cause indicated).

But the line in which the plane of the earth's equator

cuts the plane of her motion (the ecliptic) is constantly shifting in position. Suppose ABDF a view of the earth from a point on the northern side of the plane of her motion, the North Pole being at P. Then, again, let

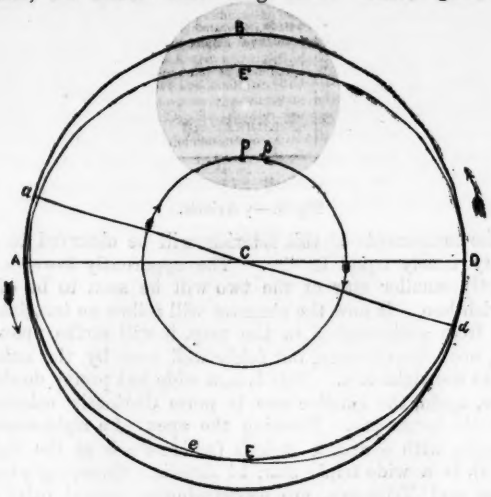

Fig. 1.

ABDF be a section taken through the earth's centre, C, and let AD be the line in which the plane of the equator, AEDE′ (E′ being on the farther or southern hemisphere),

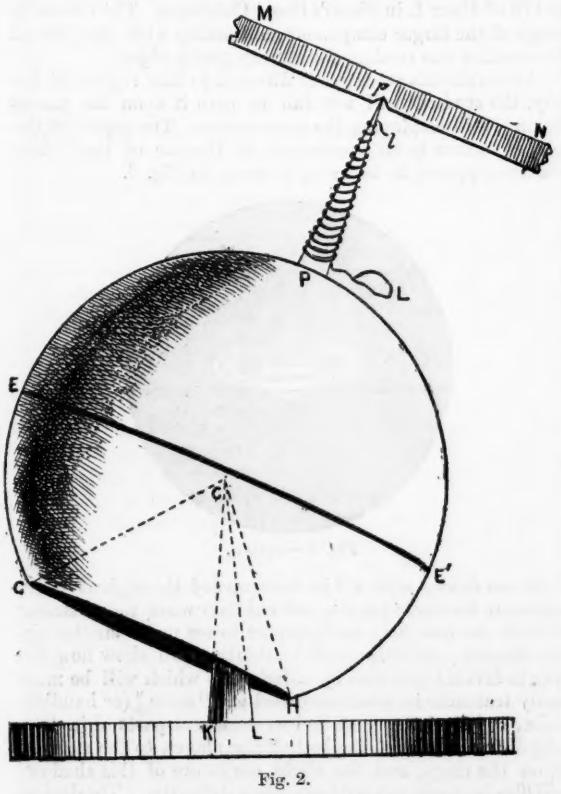

Fig. 2.

cuts ABDF. Then, if the arrow outside ABDF shows the direction in which the earth moves round her orbit, the small arrows inside show the direction in which this line of intersection is constantly travelling. In some thousand years, for instance, it would pass from the position ACD, to the position *aCd*; the equator would have passed to the position *acd* (one half only is shown), the northern pole from the position P to the position *p*.

Now, if we consider this motion carefully, paying especial attention to the movement of the pole, we see that it precisely resembles the reeling of a top. P might be the middle of the top's upper surface, C the peg, CP and C*p* two positions of the axis of the top as it reeled around C.

Or, instead of a top, the middle of the body of which is not the centre round which the reeling occurs, imagine a globe as GEPEH having a section such as is shown by the dotted lines in Fig. 2, GCH indicating where a conical hole has been cut into the globe, right to the centre. Such a globe set rapidly spinning in an inclined position (as in the fig.) on the top of a vertical spike like KCL, would be found to reel in a direction contrary to that of its rotation (just as in the case of the earth's precessional reeling), and if a circle EE′ were drawn to represent the equator, and a point P marked exactly opposite the small circle GH, this point (or preferably a point *p* at the end of a polar spike P*p*), watched from above, would be seen to move round just as the pole of the earth supposed to be watched from the direction indicated in Fig. 1.

The motion of the earth, then, by which precession is caused, resembles that of a reeling body, like a great spherical top. The period of this reeling motion is, however, so much longer than that of the revolution, that its effects seem, by comparison, very slight. The whole lifetime of a man may pass, and only the astronomer would notice the effects which it had in reality produced.

Let us see what these effects must be.

The poles of the heavens are those points on the celestial sphere towards which the axis of the earth is directed, while the celestial equator is the great circle of the celestial sphere lying midway between the poles. The celestial equator, in fact, corresponds with the earth's equator, insomuch that, if we imagine a straight line drawn from the earth's centre to any point of the terrestrial equator, and prolonged indefinitely outwards, then this line as it was carried round by the earth's rotation, would sweep out the circle which we call the celestial equator.

Now, since the earth is reeling like a gigantic top, its axis moves—just as the axis of such a top moves—over the surface of a gigantic cone. Neglecting—as relatively insignificant—the range of the earth round her orbit, we may regard the earth's centre as the apex of this gigantic cone. The points in which a line perpendicular to the plane of the earth's motion meet the imaginary celestial sphere, or the poles of the equator, are those towards which the axis of the great precessional cone is directed. Around these points the poles of the heavens revolve in two small circles, the distance of each pole from the pole of the ecliptic round which it rotates corresponding to the inclination of the earth's axis, or in arc to about $23\frac{1}{2}°$. The equator moves correspondingly, and a complete circuit is accomplished by each pole in rather less than 25,900 years.

Next week I propose to consider more particularly the effects of this reeling motion, so far as it affects the apparent position of the heavenly bodies—showing in particular how it has affected the positions of certain constellations. Then we have to consider how the seasons are affected by the change. Lastly, it will be well to consider how the reeling motion is produced, and how certain peculiarities in its progress are brought about.

In the meantime, I would invite the student to notice that very interesting illustrations of the earth's precessional

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reeling can be quite easily made. A convenient way is to have a globe of iron hollowed out, as in Fig. 2, and set in rapid rotation—which may most conveniently be done by having a projecting rod at the top, pierced to receive a string, as *l*L, and pointed, so that a metal plate, as MN, with a hollow to receive the end of axis *p*, may be held against it while the wound-up string is sharply drawn off. The heavier the globe the steadier will its motion be found to be, the slower and the more constant its reeling.

There is, however, a more perfect method of illustrating the precession of the equinoxes or the earth's *reeling*, and also the nutation (or *nodding*, still to be described), in the instrument invented by my esteemed friend, the late Mr. Burr, of the Astronomical Society. This instrument I will sketch later.

NIGHTS WITH A 3-INCH TELESCOPE.

PRESUMING the reader to be now in possession of such a telescope as that described in our first article, and that he has placed it on a firm stand of convenient height, with the bar, BM, as nearly as practicable in the meridian, we will begin our examination of the heavens by turning towards the western and south-western sky, inasmuch as the stars there situated will set sooner and sooner every night until they disappear for the season. Arming the instrument, then, with a power of 160 (a lower eye-piece may be employed to find the object), we will begin by directing it towards the star marked γ in Cetus (*vide* Map on p. 119).

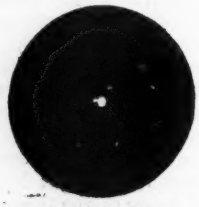

Fig. 4.—γ Ceti.

At the first glance, probably, the student will see nothing but a yellowish star of considerable brightness; but, by careful attention, he will not be long ere he catches its small companion, seemingly to the left of and just below a horizontal line, passing through the larger star. Its blue or dusky tint will at once strike the observer, as well as its small size as compared with that of its primary. This elegant pair form what is known to astronomers as a "binary system"; in other words, the stars are physically connected, and the smaller star revolves round the larger one—or both round their common centre of gravity—in a very long period, the exact duration of which is as yet undetermined. There are other objects of interest in this constellation, but the difficulty of recognising them without the aid of an equatorially-mounted telescope, furnished with graduated circles, compels us to omit reference to them in these very elementary papers. Among them, 66 Ceti may be mentioned as a charming pair. It may be found—with numerous other doubles—on Map 3 of Proctor's "Star Atlas."

Above, and to the right of that part of Cetus in which γ is situated, will be seen a curved line of three stars (Map on p. 204); the chief ones in Aries, the bottom, and least of which is remarkable as being the one of which Hooke wrote in 1664, "I took notice that it consisted of two small stars very near together; a like instance to which I have not else met with in all the heaven." It is almost needless to tell the student that double stars are now numbered by thousands. Viewed with a power of 160, γ Arietis presents the appearance shown in Fig. 5.

Fig. 5.—γ Arietis.

The components of this asterism will be observed to be pretty nearly equal in size. The apparently lower and slightly smaller star of the two will be seen to be of a greyish hue. If now the observer will follow an imaginary line from γ through β in the map, it will strike upon a star, not lettered there, but fairly well seen by the naked eye to the right of α. This is λ, a wide but pretty double. Here, again, the smaller star is more distinctly coloured than the larger one. Forming the apex of a right-angled triangle, with α and λ Arietis (whereof α is at the right angle), is a wide triple star, 14 Arietis. Sweeping where Aries and Triangula are conterminous, several pairs of small stars will pass across the field of view. Some 2° (four times the diameter of the Sun or Moon) above, and to the right of β, Arietis (as seen by the naked eye) will be found a beautiful close double star, which will tax the powers of the incipient observer to see fairly separated. It is 179 of Hour I. in Piazzi's Great Catalogue. The yellowish tinge of the larger component contrasting with the blue of the smaller one renders this a very pretty object.

And while his telescope is directed to this region of the sky, the student will not fail to turn it upon the planet Saturn, still employing the same power. The aspect of the planet as seen in an instrument of the size of that which we are supposed to be using is shown in Fig. 6.

Fig. 6.—Saturn.

It was drawn with a 3-in. telescope of the highest class, expressly for these papers, and exhibits what the possessor of such an one may fairly expect to see under similar circumstances. A little careful attention will show how the ring is divided into two by a dark line which will be most easily traceable in what are called the "ansæ" (or handles)—*i.e.*, in the easternmost and westernmost parts of it. The inky-black shadow of the ball of the planet, to the right of it, on the rings, and the slight curvature of this shadow, will also be made out without much difficulty. The darker shading on the southern half of Saturn's globe, and the bright belt on the planet's equator between this polar capping and the ring, will be recognisable without diffi-

culty. His largest moon, Titan, will be seen at once, and Japetus (which was visible, as shown, when the drawing was made) may, perhaps, be picked up. Tethys, Dione, and Rhœa, are too severe tests for a 3-in. object-glass, and the other three satellites are hopelessly beyond much larger instruments. The incipient astronomer must not expect to perceive all the wonderful Saturnian detail shown in astronomical books. Should his 3-in. telescope show him exactly what is exhibited in the engraving, he may rest assured that he is the possessor of a first-rate instrument. Neptune, who may be found from the map, will be undistinguishable from a fixed star with the optical means at our command. Jupiter, however, represented in our next figure,

Fig. 7.—Jupiter.

is a brilliant and most conspicuous object, and the eye of the novice will have to become accustomed to the brilliance of his light before much detail can be made out upon his surface. At the period in his rotation, corresponding to that at which our sketch was taken, the great red spot which has been such a conspicuous object on his disc for the last two or three years will be at once recognised; a dark belt to the east, and somewhat above (or south of) it, bending down seemingly towards it. Then, north of the great spot, we note a well-defined band, the darkest portion of the planet's surface. The northern edge of this, and the southern edge of a belt nearly on the planet's equator, enclose an irregularly-formed lighter area between them. They are succeeded by a third dark belt, after which the whole of the planet's limb up to his north pole is covered with a continuous shading. Jupiter has four moons, but their positions are so continually shifting as to render it impossible to insert them in any drawing, unless its exact epoch be given. They may all four be outside of the planet's disc, or on the same side, or some on one side and some on another. Or they, or one or more of them, may be hidden in the shadow of Jupiter, or be passing across his face. In this latter case, the shadow of the crossing satellite may be detected like a little circular dot of ink upon his face. Our sketch of Jupiter, we must warn the young observer, is made on a smaller scale than that of Saturn, the latter having been enlarged to exhibit detail. When the observer has gazed his fill upon this superb planet, he may raise his telescope to that lovely object γ Andromedæ (above Triangula in the map). The contrast between the yellow of the large star and the exquisite green of the small companion is very striking. π Andromedæ to the right of β is a very pretty object, the contrasting colours being in this case very pale yellow and blue. 59, Σ 3, P. XXIII., 240, and other beautiful pairs will be found marked in Proctor's "Atlas."

Exchanging now his high power for the lowest one supplied with his telescope, the beginner should fish a little above to the right of ν Andromedæ (see map, p. 204) for that most remarkable object, 31 of "Messier's Catalogue," the well-known great nebula in Andromeda. Sir John Herschel quotes Simon Marius as describing the appearance of this nebula as resembling that of a candle shining through horn; and this really does not give a bad idea of it, as viewed in such an instrument as that which we are using. We purposely abstain from giving any figure of this nebula, inasmuch as no woodcut is competent to reproduce the peculiar effect of a nebula, and our object is to show as exactly as possible what the reader, furnished with a first-class 3-inch achromatic, may expect it to show him.

None of the larger stars in Taurus present any features of interest in small telescopes. χ Tauri is a somewhat wide, but pretty pair. It is the one above the letter S in the word "Taurus" in the map on page 119. Identification of the smaller ones without graduated circles is almost hopeless. Using a low eye-piece through, the Pleiades present a fine spectacle; and about two diameters of the moon, above and to the right of ξ Tauri, will be found a pale, elongated nebula. A low eye-piece, too, must be used for this. Nearly over head, just now, Perseus will be observed; a constellation rich in objects of interest, of which, however, we can only give an account of a very few suitable for the instrument we are employing. Reference, as before, must be made to the maps on pages 97, 119, and 204 for their identification. ε is a very fine pair, but the smaller star requires some little looking for. It is as shown in Fig. 8 below, and *just* to the right of its primary. ζ Persei is really a quadruple star, although the student will scarcely discern more than three out of its four components with the aperture we are considering. η is another pretty pair, too, but somewhat difficult, from the faintness of the companion. Perseus contains several interesting clusters—notably one of the most glorious fields of stars in the whole heavens, in what is called the "Sword-handle." This may be seen by a sharp-sighted person with the

Fig. 8.—ε Persei.

naked eye between Perseus and Cassiopeia (map on p. 75) as a bright spot in the Milky Way. This superb object requires the lowest eye-piece in the observer's possession to do it anything like justice. No view of it, however, with so small an aperture will give any idea of the gorgeous effect it presents in a large instrument.

South of Aries and the Pleiades lies the straggling constellation Eridamus. It contains numerous interesting pairs of stars; but for them the student must sweep, if confined to the maps in KNOWLEDGE, as they are not numbered there; and hence, any attempted description of their localities could only be confusing. 32, 39, 55, and P III., 98 will all be found to be beautiful and attractive objects, and are marked in Proctor. A curious planetary nebula $\frac{1}{0}$H IV. 26, seen best with a low power, will be found there too. Having then furnished the incipient star-gazer with a good hard night's work, we take leave of him for the present. In our next lesson we propose to deal with that splendid and all-repaying constellation, Orion.

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FOUND LINKS.

By Dr. Andrew Wilson, F.L.S., &c.

PART II.

TURNING now to the last-named fishes (*Lepidosiren* and *Ceratodus*), we discover that their fish-characters exist on the very surface of things. Their blood is cold; their bodies are scaly; they have fins and fin-rays; and above all, they possess gills existing in the sides of the neck, and in which, so long as they swim in the water, their blood is purified. But here the fish-characters end. Another aspect of the mud-fishes and the barramunda reveals characters which startle us as being not those of fishes, but those of frogs; and frogs, toads, and newts form, as every one knows, the second higher class of vertebrates, that of the *Amphibia*.

Firstly, then, the *Lepidosiren* possesses a heart, which is not that of a fish, but modelled on the type of the frog or reptile heart. Instead of being two-chambered, it is three-chambered; and no other fish save itself possesses such an advance on the ordinary type of fish-heart. But, secondly, their "paired fins," which represent in all fishes the "limbs" of higher animals, resemble—in the mud-fishes at least—rudimentary limbs. Then the nostrils, thirdly, open into the mouth—a character agreeing with frogs and all higher vertebrates, but possessed by one other fish-group only—the low hag-fishes, which are poor relations of the lampreys. These characters, then, are the characters of frogs, and not of fishes. But a far more interesting likeness to the frogs and higher vertebrates yet remains for notice. The "air bladder" of the mud-fish and of the "Jeevine" alters wonderfully, both in form and function, from its nature in other fishes. It becomes divided in two, and it opens into their throat by a windpipe, at the top of which is a "glottis," corresponding to part of our own organ of voice. Furthermore, it is divided internally into cells—in a word, the air-bladder of the mud-fish and its neighbour *has become a lung*. But this wonderful transformation is not quite ended with the recital of the altered structure of the air-bladder in these fishes. A lung is an organ which not merely receives blood in an *impure state*, but which, as in ourselves, returns that blood *pure* to the heart for re-circulation through the body. If, therefore, the "lung" of the fish is to be accounted a true "lung," we should be able to show that it performs the functions and discharges the duties of an organ of breathing.

Now the life of these fishes exhibits exactly the peculiarities which demand the exercise of an air-breathing organ like a lung. The mud-fishes inhabit their native rivers during the wet season; but when the dry season approaches, they bury themselves in the mud, and lie there, baked as in a kind of mud-pie, until the return of the persistent rains. During this land-existence their "lungs" come into play. So long as they live in their native waters, they breathe by their gills like ordinary fishes; but, ensconced in the mud, they breathe air directly from the atmosphere, like ourselves. The air-bladder purifies the blood, which the heart pumps into its vessels, and from the "lungs" the purified blood is returned to the heart. The fish is thus truly a "double-breather;" it exhibits in itself the combination of the characters of the frog and the fish. Dr. Günther tells us that whilst the mud-fishes remain in the "torpid state of existence, the clay-balls containing them are frequently dug out, and, if the capsules are not broken, the fishes imbedded in them can be transported to Europe, and released by being immersed in slightly tepid water." The "Jeevine," with its similar "lung," is said to leave the Australian rivers at night, and to waddle its way to the marshes and swamps, there to feed upon the vegetable matter that forms its staple food. In the nocturnal journeyings of the fish we can readily perceive the utility of the "lung."

It may lastly be remarked that other fishes are known to leave the water and to exist for a time on land. The climbing perch of India, and the *Ophiocephali*, also of India, illustrate such fishes; but in these forms the breathing in air is contrived in a different fashion from that process in the mud-fishes, and has no connection with any "lung."

Let us now reflect that a frog itself begins life as a fish. The "tadpole" has gills and a fish-heart, whilst it has no lungs. Ultimately it acquires lungs and loses gills and tail as its mature shape is attained. Summing up these plain facts of zoology, I think it is not difficult to see that in the mud-fishes and "Jeevine" we find a "link" between the lower water-living fishes and the air-breathing frogs. If we suppose that a form like the mud-fish could rid itself of its gills when it became adult, and that it could throw off the scales of the fish, and develope the limbs of the frog, we might figure to ourselves the ascent of the frog-type from the fish-type. There is nothing more wonderful or impossible in this idea than in the veritable fact that every frog is at first a fish, then a tailed newt, and only ultimately becomes the amphibian. Anyhow, one fact seems clear enough, that fishes and frogs—two utterly distinct classes—are "linked" by the mud-fishes and "Jeevine;" and this single fact in itself supports powerfully, in a rational view of matters, the theory that the air-breathing tribes of animals sprang originally from water-living forms. We shall see in future papers that "links" even of stranger kind unite classes of animals as dissimilar as the fishes and the frogs.

FALLACIES ABOUT LUCK.

By the Editor.

WALKING down to the boat-houses, one day, when I was at Cambridge, a friend (now a clergyman) who was taking part, like myself, in the four-oared scratch races, remarked that his boat was sure not to draw the unlucky first place that day. "How's that?" I asked. "Why, because we have had to row first every day until now, and the luck is sure to change to-day." (It may be necessary to explain that boat-races on the Cam are bumping races—unless where time races are rowed between the last two or three left in—and that the first place is, of course, the worst in a bumping race, for the simple reason that the first boat shares with the others, all but the last, the risk of being bumped, but cannot make a bump. In the eight-oared races, indeed, the first place is the place of honour, attained by bumping boats below; but where, before a race, lots are drawn for position, the first place is the worst, the last place the best.) I tried to explain to my friend what seemed so obvious as to need no explanation, that his fate in the day's drawing could not possibly be affected by the results of previous drawings. The simple circumstance that to draw a given place day after day, for six days (five were past), was a thing unheard of, so far as he knew, sufficed to assure him that his coxswain would not that day draw a particular ticket. It so chanced that what he was sure would not happen did actually happen, though it would in no way have affected my argument if his hopes had been fulfilled.

The mistake made by my friend on this occasion is one of the commonest fallacies respecting the laws of chance. Of course, it requires no mathematical knowledge or reasoning to show the opinion to be quite erroneous that past events can in any way influence events which are of their very nature entirely independent of them. If there is an urn in which we know that there are a number of white and a number of black balls, and we draw one after another several white balls, *not returning them*, we have some reason for thinking that we are more likely to draw a black ball at the next trial, for every white ball drawn diminishes the chance that the next one drawn will be white. But if each ball after being drawn is replaced, it is evident that the chance of drawing a white ball at any given trial must be the same as that of drawing it at the first or at any other trial. Or take the tossing of a coin. Antecedently it seems so unlikely that head (say) will be tossed ten times running, that we can easily imagine how anyone who had tossed head nine times running might entertain for a moment the idea that he was less likely to toss head the tenth time. But if he had any reasoning power at all, and used it, he would see that no number of past trials could in any degree affect the next tossing.

There is a fallacy equally common, and held commonly by the same persons who make the mistake just considered, which yet is opposite to it in character—in fact, directly contradictory to it. The mistake we have dealt with above may be called belief in the change of luck, and in a somewhat disguised form it is this foolish fallacy which leads the weak-minded pigeon to fall an easy prey to the rooks, from the fond delusion, in which, of course, they encourage him, that though he has lost—or rather because he has lost for a long time—he must presently begin to win. The fallacy we have next to mention is faith in luck. You will hear people say that they never have luck in games of chance, or that they always have luck; and you will find hundreds ready to believe in the good luck or bad luck of others. We say that this belief is contradictory to the other. If it be considered for a moment, this is seen to be the case. What does belief in a man's good or bad luck mean but that, because he has been fortunate or unfortunate for a long time he will continue to be so? and what does the other belief mean but that, because the luck has been one way for a long time, it will no longer continue to be so? One would suppose that two ideas so incompatible with each other could not exist in company; that everyone must see one or other to be fallacious, or (which, of course, is the actual case) that both are so. Both views are in fact ridiculous, though both, with many other equally preposterous superstitions, are entertained by persons who are not supposed to be wanting in keenness of perception, and in other matters are intelligent enough. Here, for instance, is an account given by one keen card-player of another who was as keen, or keener. "He was very particular about cutting the cards; he always insisted on the pack being perfectly square before he would cut, and that they should be placed in a convenient position. There is an old adage that a slovenly cut is good for the dealer, but whether there is truth in the statement we know not. He was superstitious to a degree that was astonishing." (It must be a rather startling superstition that would seem astonishing to a man who could gravely ask whether there is any truth in the preposterous adage just quoted.) "We are not aware that any one has ever attempted to solve the problem why so many great minds" (among card-players, fighting men, and men who have to work much at odds with fortune) "are superstitious. This is not the time or place to attempt that solution. We record the fact. He believed in dress having something to do with luck, and if the luck followed him, he would wear the same dress, whether it was adapted to the weather or not. He believed in cards and seats. He objected to any one making a remark about his luck. He had the strongest objection to our backing him, because of our bad luck, and we have often had to refrain from taking odds, because of this fad. He was distressed beyond measure if any one touched his counters. His constant system of shuffling the cards was at times an annoyance." This was a great card-player.

It will be asked, perhaps, how cases of notoriously lucky men are to be accounted for, if there is no such thing as luck. If the laws of probabilities say that no man can be regarded as a lucky or unlucky man in matters of pure chance, how is it that so many men have been lucky or unlucky? But science by no means denies that men have been or will be lucky or unlucky; on the contrary, the laws of probability can *prove* that among the millions who try their fortunes in matters of pure chance, thousands must be exceptionally lucky or unlucky, and a few must have luck perfectly marvellous to all who witness it. Given the nature of any chance game and the number who play at it, science can tell, within very narrow limits of error, how many will have ordinary luck, how many will have moderately good, or moderately bad luck, how many will be very lucky or very unlucky, and how many will have absolutely astounding luck of one sort or the other. When Science is asked how, with her absolute rejection of all faith in luck, she can account for men who have had amazing runs of good or bad luck, Science can reply not only that she has no difficulty in accounting for them, but that she can prove this to be to all intents and purposes inevitable.

What, then, is it that science rejects as untenable, or how, with such views, can science be truly said to have no faith in luck? The answer is, that the laws of probability —and (rightly understood) the laws of common sense— forbid our believing that a man *is* either lucky or unlucky. He may have been so; but, so far as matters of pure chance are concerned, the man who has been most unlucky is as likely as not to be lucky at any given trial as one who has been exceedingly lucky. He is not more likely to be so, as the fallacy respecting change of luck implies, nor is he less likely, as the fallacy of faith in luck implies; he has simply just the same chance as another, neither better nor worse.

If twenty million persons in England were to begin tossing a coin, each stopping so soon as he tossed "tail," and each to receive a pound for one head, two for two heads, four for three, eight for four, sixteen for five, and so forth, it is practically certain that several would win a prize of £131,072 after tossing head eighteen times running, and all but certain that some would get the prize of £262,144 for tossing head nineteen times running, and one or two perhaps the prize of £524,288 for tossing head twenty times running. These would all have been very lucky persons (and as long as they kept their winnings, we may say that they were in luck afterwards as well as before). The laws of probability show that among so many trials there must be some such lucky persons. But, supposing the experiment repeated, science assures us that those persons who had been so lucky would have neither a better nor a worse chance of success than those who had had but moderate luck, or the unfortunates (some ten million in number) who had tossed tail at the first trial. What would believers in the two fallacies we have considered, think? If they had watched one of the luckiest tossers, would they say that, as he had tossed head so many times running, he was unlikely to toss a single other head in the second trial

or that, as he had shown himself a lucky man, he was sure to continue tossing heads in the second trial also? One idea is as consistent with the common fallacies about luck as the other. Both cannot be true; but, in point of fact, they are alike erroneous. Carefully studied, each is seen to involve an absurd mistake.

THE PRINCIPLE OF THE VERNIER.

By J. R. CAMPBELL.

THE vernier is a short scale, which, applied to the edge of another, on which we measure a length, enables us to read to within a certain fraction of the smallest division of the latter scale. Thus, suppose the scale we measure on to be divided into tenths of an inch, by means of a suitable vernier we can read to within the hundredth of an inch.

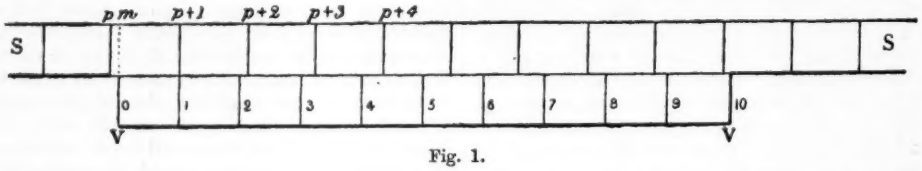


Fig. 1.

In Figs. 1 and 2, SS represents a portion of an ordinary scale of equal parts, reading from left to right, p being p^{th} graduation from the zero on the left, and $p+1$, $p+2$, $p+3$, &c., the graduations which follow; the distance between each being = 1 unit. Suppose m to be some point lying between p and $p+1$, at a distance x from p, then the vernier VV is a contrivance for giving us the numerical value of x, to within a constant fraction of the unit, supposing its zero to be on m.

Let us suppose the fraction to be $\frac{1}{10}$. In this case VV has a length = 9 divisions of SS, but is itself divided into ten equal parts, figured 1, 2, 3, to 10. Each division of the vernier will, therefore, be $\frac{9}{10}$th of a unit. If now we find that (as in Fig. 1) the graduation 1 on the vernier coincides with the graduation $p+1$ on SS,

$x = 1 - \frac{9}{10} = \frac{1}{10}$, and for the measurement we read $p + \frac{1}{10}$.

If 2 on VV coincides with $p+2$ on SS,

$x = 2 - 2 \times \frac{9}{10} = \frac{2}{10}$, and we read $p + \frac{2}{10}$.

If 3 on VV coincides with $p+3$ on SS,

$x = 3 - 3 \times \frac{9}{10} = \frac{3}{10}$, and we read $p + \frac{3}{10}$,

and so on.

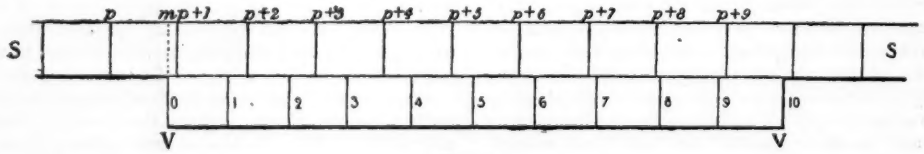


Fig. 2.

In Fig. 2, 8 on VV *more nearly* coincides with $p+8$ on SS than either 7 with $p+7$, or 9 with $p+9$. In this case, therefore, $x = \frac{7}{10}$ + a fraction less than $\frac{1}{10}$, and we take $p + \frac{8}{10}$ as the measurement required.

Were the length of the vernier = 29 divisions of SS, and that length portioned into 30 equal parts, each would be the $\frac{29}{30}$ th of the unit; and it is easy to see that such an arrangement would read to within the $\frac{1}{30}$ th of a unit on SS. Generally, if the vernier be of a length $= n-1$ units on SS, and consist of n equal divisions each $\frac{n-1}{n}$, it will measure to within the $\frac{1}{n}$ th of a unit.

The advantage gained from the employment of a vernier arises from the fact that the eye can determine the coincidence of two lines, when it cannot accurately judge the distance of other lines which do not coincide, thereby rendering a minute subdivision of each division on SS unnecessary.

Verniers are mostly applied to the measurement of arcs of circles, and form an important element in the theodolite, sextant, and other instruments of that class. In these, the scale SS forms a portion or the whole of a circle, and the vernier is an arc having the same centre. In measuring an angle by means of these instruments, we move the vernier, the scale of degrees, SS, being fixed.

COLOURS OF ANIMALS.

THE colour and flesh of trout are affected by the water and bottoms they haunt. I know a river, the upper water of which passes over gravel and sand. Below that length, it streams through bog and alder scrub. In the first length, the fish are golden, well-formed, and good food. In the bog length they are black, bull-headed, and flabby—utterly good-for-nothing. He must be a starving otter who would make a meal of them. When these trout passed into good water, they recovered shape and condition. Again, I once lived in a wild part of Ireland. Opposite, and close to my house, there was a lake connected to another lake by an outflow. The water of the one, or upper lake, was clear, resting on brilliant white sand—a thoroughly raw bottom. The trout in it were bright and light in colour, not plump, white fleshed, and tasteless as dace. The lower lake was on bog and blown sea-sand. The water was darkish. In this, the trout were something to look at. Dark backs, merging into bright olive on the sides, and shading into white on the belly. They were beautifully spotted. Cooked, these fish excelled in delicacy of flavour any salmon I ever tasted. Now, these lower lake trout were the same as the white lake trout, but changed in appearance by different conditions of water and food. That the upper lake trout came down to the lower lake was notorious; but none was ever caught in its original condition. Was this change for concealment?

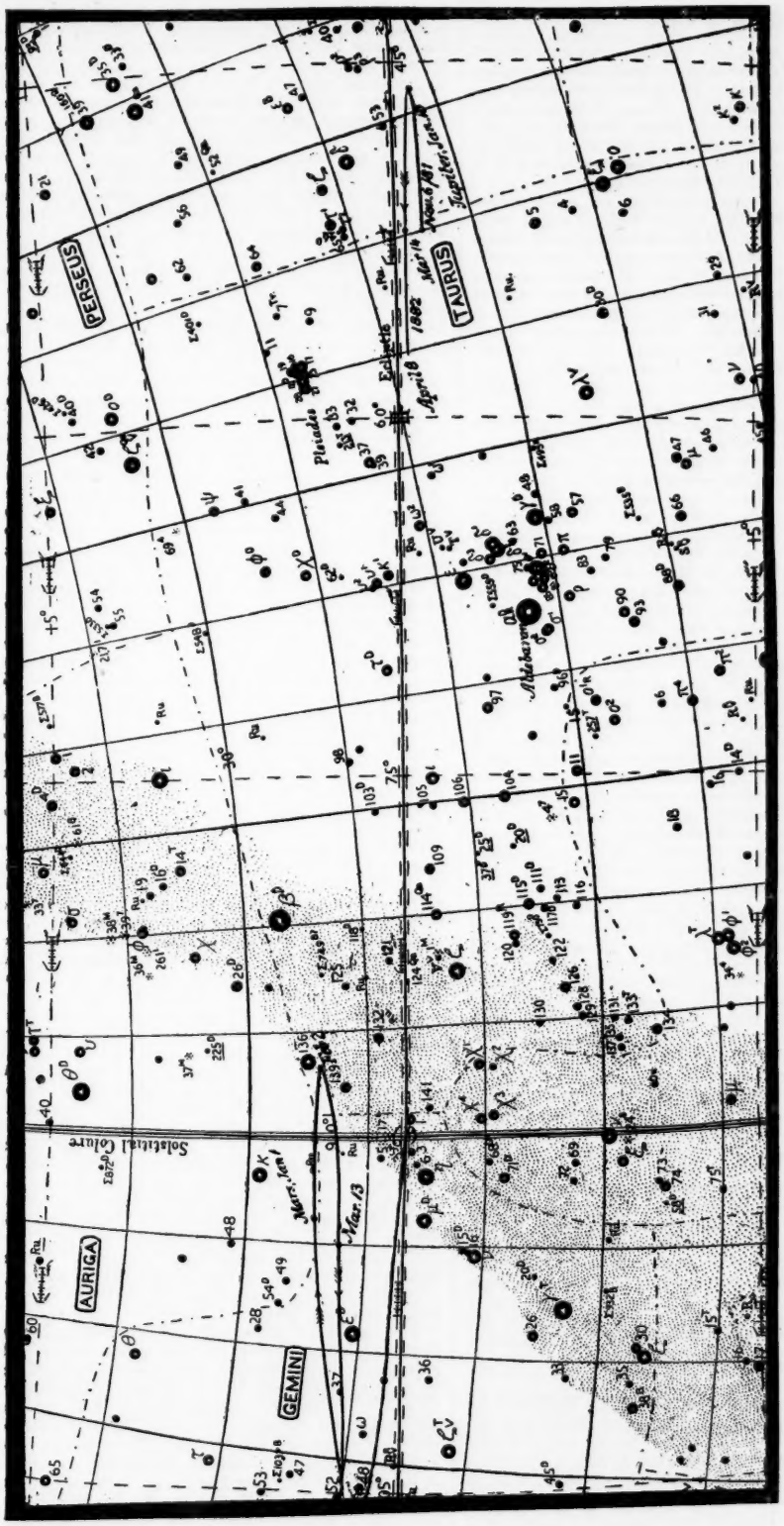
The flying-fish in the Gulf-stream have markedly the blue tint of the stream, and are of darker hue in the darker sea-water. Was this for concealment? [We should say yes.—ED.]

A lady, accurate in observation, has told me that the eggs of the cloth-moth vary in colour with the colour of the cloth they are deposited on. Is that for concealment, or from an explainable cause?

I cannot accept Mr. Darwin's worm theory in its totality, and I repeat that which Dr. Wilson affirms is "a trifle too near silliness," namely, that the theory of worm action on the soil is an elaboration of exceptional minutiæ into huge paradox. [Might it not be well if our correspondent would mention some statement or conclusion in the work, to which he objects?—ED.]

Dr. Wilson's answer to 'Ornithorhynchus," on the toad's immunity from the common effect of bee poison, misses the fact. The toad that munches a bee is not stung. He darts his long rapier tongue like a flash of lightning at the bee, and as rapidly withdraws it, with the bee fast to his mouth. The bee is killed before it recovers sense to sting. Neither bee nor wasp will sting when in a state of sudden terror. B. DONBAVAND.

ERRATUM ON PAGE 179, No. 9.—In the sixth line of the fourth paragraph of the article on "Primary Colours," insert a colon after "not," and delete the full stop after "theorists."—E. H.



ZODIACAL MAP.

WE give a map this week showing on an enlarged scale (as compared with the monthly map) the part of the Zodiacal map best suited for observation during this month and the next. (The map is reduced from the editor's larger Star Atlas, Map IV.) The path of Mars during its present approach to our earth is shown, as also the path of Jupiter. Many of the stars, of which "A Fellow of the Royal Astronomical Society" will have occasion to speak during the next few weeks, will, we doubt not, be within the limits of the region pictured in our map

THE PYRAMID OF MEYDOOM.

By Amelia B. Edwards.

TO open the Pyramid of Meydoom was one of the unfulfilled projects of the late Mariette Pasha. Prof. Maspero takes Egyptologists by surprise in achieving this great work during the first weeks of his second year's campaign. For more than a month it had been known to a few of his private friends that he had a gang of fellaheen at work upon this pyramid; but the secret has been faithfully kept; and not till success was actually achieved was it even suspected in the public offices and hotels of Cairo.

The Pyramid of Meydoom, situate about a mile and a-half to the north-west of the village of Meydoom, is built in three stages, each inclined at an angle of 74° 10′. It rises to a height of 122 ft. from the midst of a high hill of fallen masonry and rubble. The first stage shows a height of 69 ft.; the second measures 20½ ft.; the third, which is much ruined, measures 32 ft. in height. The outer masonry is of admirable workmanship, and consists of polished blocks of Mokattam limestone. The general effect of the structure is very imposing. It has been aptly compared to the keep of a Norman castle, if we can imagine a keep built in three superimposed stages. Archæologists have till now believed that this pyramid was inviolate. Dominating a vast burial-field containing the *mastabas*, or built sepulchres, of many nobles and "royal relatives" of Seneferoo, the last king of the Third Dynasty, it is supposed to be the pyramid of that monarch. It would in such case be of earlier date than the pyramids of Gheezeh.

Professor Maspero began his work by opening a vertical trench down the northern face of the mound out of which the pyramid rises; the first result being to show that the masonry goes down to the level of the desert, and that the mound is entirely formed of accumulated sand and *débris*. Professor Maspero believes this *débris* to be very ancient, and thinks it may even date as far back as the end of the New Empire. The entrance was found precisely in the centre of the north face of the first stage, about 20 mètres above the level of the plain; which would give about 134 feet for the actual height of the first stage as now laid bare. This entrance was opened on the 13th of last month. It gave access to a descending passage about 1 mètre 60 centimètres square. The incline of this passage is very steep, and for the first 10 mètres it is lined with masonry finer, if possible, than that of the external facing. At a depth of 10 mètres the passage strikes the living rock, and becomes in its continuation an excavated sloping shaft of the same dimensions as before. The pyramid, for at least half its height, is therefore formed upon a core of rock, around which the pyramidal structure is elevated. About 5 mètres from the entrance there was once a "stopper" stone, which closed the mouth of the passage. This "stopper" has disappeared; but the construction of the passage shows that it was contrived quite differently from the portcullis-stones of the Gheezeh pyramids. There is no void in the roofing above where it is placed. It must, therefore, have been inserted after the mummy was laid in the sepulchre; then filled up to the level of the outer wall, and covered with the same *revêtement*, so leaving no external trace. The removal of this stone must have been effected at a very distant time, there being three hieratic inscriptions of the period of the XXth Dynasty scrawled upon the ceiling at the very point which the stone formerly occupied. These inscriptions, written in accordance with a brief formula common to the epoch, merely record the visit of two Egyptian tourists—the scribe Sokari and the scribe Amenmes. Hence it would seem that the pyramid of Meydoom was open, and visited by the curious, as early as the XXth Dynasty. The descending passage has been cleared to the depth of 40 mètres, without any landing, branch-passage, or chamber having yet been reached. Thus far, the structural arrangement seems to reproduce the internal plan of the Great Pyramid. The work is of extreme difficulty, owing to the want of air and light, and the overwhelming heat. The workmen faint from time to time, and have to be carried out. Prof. Maspero finds it impossible to stay inside for more than half-an-hour together.—From the *Academy*.

VEGETABLE POISONS.

THE evidence in reference to the death of Percy Malcolm John was of a character which seems to leave no doubt that the deceased was poisoned by aconitine, however or by whom it may have been administered. The medicinal qualities proper to various of the most active members of the vegetable kingdom, such as opium, hemlock, aconite, hellebore, cinchona, and others, have long been known to be due to the presence in their juices of substances called their active principles, and known chemically as alkaloids. Of these, quinine, the active principle of cinchona bark, and morphia, the active principle of opium, are of such comparatively slender potency that they are constantly administered in medicine, and their names have become household words—even to the extent, in the case of morphia, that it has lost its original French designation of morphine, and has become Latinised or Anglicised in common use. When the active principles were first discovered, they were almost entirely manufactured or separated in France, for the reason that the process required the employment of a large quantity of rectified spirit or pure alcohol, and that the excise duties on alcohol had not then been relaxed in favour of chemical manufactures, and were practically prohibitory in this country. The analysis of vegetable poisons, in quest of the active principles which they might contain, fell almost exclusively into the hands of French chemists; and hence these active principles, when separated and identified, were naturally called by French names. With those which are so powerful as to be dangerous in any but the most skilful hands, and which have never been popularly known or talked about, the French terminology has been commonly retained; and hence the active principle of hellebore is still called veratrine, and that of aconite aconitine. The aconite itself is the plant known to botanists as *Aconitum Napellus*, and familiar in many old-fashioned country gardens as monkshood, and its graceful form, dark and deeply indented foliage, and tall spikes of large dark blue flowers, are attendant upon one of the most deadly poisons which are contained in the vegetable kingdom. The root bears a superficial resemblance to horseradish, and there have been numerous instances in which this resemblance has led to fatal consequences. It cannot strictly be said to resemble horseradish in taste, but it produces upon the tongue a peculiar sensation of tingling, followed by prolonged numbness; and it has been eaten as horseradish over and over again, in sufficient quantities to cause the deaths of many persons, and serious illness to many others. When such is the virulence of the root itself, it cannot be matter for surprise that its alkaloid, or active principle, separated from every inert constituent, should be dangerous to man in a dose of the fiftieth of a grain, and fatal in the dose of a tenth of a grain; or that it should produce, in an intensified degree, the peculiar tongue sensation which is produced by chewing the plant itself. It is by these characteristics that the analysts, Dr. Stevenson and Dr. Dupré, have been able to identify aconitine as the poison which proved fatal to the deceased.

The vegetable alkaloids, when administered for criminal purposes, were long thought to present peculiar difficulties to chemists. The fatal dose might be so small in absolute amount as to be easily lost among the other ingredients of a meal, or the other constituents of the animal body; and the substances themselves do not offer the facilities for analysis with which we are familiar in the case of the mineral poisons. A preparation having a metallic base, such as arsenic or antimony, is practically indestructible; for, if it is swallowed in sufficient quantities to cause death, this base must always be present in the remains in a condition in which it can be separated and identified by processes of the simplest kind, with which it is the business of every medical student to be familiar. The alkaloids, on the other hand, instead of having permanent bases peculiar to themselves, are composed of the same elements which build up the fabric of the body, and of the food from which its sustenance is derived, and there are very few of them which, in the presence of any tests, yield reactions that can be described as positively characteristic. In these circumstances physiology has come to the help of chemistry, and the practice which is pursued is, in the first instance, to treat the contents of the stomach, or the substance of the viscera, in such a way as to extract from them any alkaloid which they may contain, and then to test this extract by its effects when administered to small animals, instead of by its behaviour in contact with re-agents. The evidence of Dr. Stevenson is to the effect that he made an extract from the matters submitted to him for analysis, and that he administered minute quantities of this extract by injecting it under the skin of mice, which thereupon died with symptoms of aconite poisoning. It further produced upon his own tongue and upon that of Dr. Dupré the characteristic tingling and numbness which would be produced by aconite, and which lasted from four to six hours; and, finally, some mice were poisoned with genuine aconitine, and their symptoms were compared with those exhibited by the mice poisoned by the extract. In this way the chemists were able to arrive at a conclusion which they appear to have placed beyond dispute. The body of the deceased contained aconitine enough to have killed a dozen people; and no one who had swallowed the alkaloid in the amount in which it was shown to have been present could have had, from the first moment, even the smallest chance of escape. In its legitimate uses, indeed, aconitine is scarcely ever employed by physicians except as an external application. A minute quantity of it is sometimes pre-

scribed as the basis of an ointment, which is rubbed into the skin in some forms of obstinate neuralgia, but its internal administration would be attended by perils, from accidents in dispensing or in the measurement of the dose, which no prudent practitioner would be likely to incur.—*Times.*

THE NEW STAR IN CASSIOPEIA.

THE following particulars respecting this wonderful star may be of interest to your querist and other readers (see query 65). The star known as the "Pilgrim," which suddenly blazed out in Cassiopeia in 1572, was, according to Smyth, first seen by Schaler, at Wittenberg, in August, 1572. Tycho Brahé, whose name is usually associated with the star, first saw it November 11. It increased in brilliancy until it surpassed Jupiter, and equalled Venus in brightness when it was visible at noonday. This state of things was not, however, of long duration, as it gradually diminished, and in March, 1574, had completely disappeared. Its curious changes are thus described:—"As it decreased in size, so it varied in colour; at first its light was white and extremely bright; it then became yellowish, afterwards of a ruddy colour, and finished with a pale livid colour." Smyth incorrectly gives its position as north of 55 Cassiopeiæ. This mistake has not been corrected by Chambers in his new edition of the Cycle. A reference to the original sketch, by Tycho Brahé, accompanying his description of the star, shows that it was situated close to κ Cassiopeiæ—a star of about fourth magnitude. The place deduced by Argelander, from Tycho Brahé's observations, is, for the year 1878, R.A. 0h. 18m. 2s. 1; N.P.D. 26° 31′ 43″. The position thus indicated is very void of stars to the naked eye, and even in an opera-glass.

Within one minute of arc of the place assigned by Argelander, d'Arrest, in 1865, observed a small star of the eleventh magnitude, of a reddish hue. By frequent comparisons made by Hind and Plummer in 1873, they found that this small star, which is No. 129 of d'Arrest's catalogue, is sensibly variable to the extent of nearly a magnitude. "It frequently presented a more blurred appearance than the neighbouring stars, and on several nights was remarked to flash up very sensibly for moments, assuming at these instants a redder tinge than at other times. The star assumed to be Tycho's will be readily identified by means of a bright ninth magnitude—8·9 according to Argelander, which is No. 22 of his Zone 60. It follows this ninth magnitude 29ˢ·6, and is south of it 10′ 4·1.'" D'Arrest's star was also observed by Espin in 1878. Sir J. Herschel thought it probable that the object was identical with temporary stars which are said to have been seen in the same region of the heavens in the years 945 and 1264. Should this be the case, the next few years may possibly witness a repetition of this extraordinary phenomenon.

J. E. GORE.

ACTINIUM; A METAL FOUND IN WHITE ZINC PIGMENT.

DR. T. L. PHIPSON'S experiments have at last proved successful, and he describes the process by which he has isolated the oxide and sulphide of the new metal, "actinium" (to which white zinc pigment owes its remarkable property of darkening in the sunlight, returning to its white state in the dark, and not being affected in this manner under a sheet of glass), in a state of tolerable purity. He says:—

Perhaps this process may be improved hereafter, but it is not very complicated, though it has required an enormous number of experiments to arrive at it. First, one word as to the manner in which the pigment found in commerce is prepared. Ordinary zinc scrap is dissolved in sulphuric acid, and a considerable excess of zinc is left in the solution in order to keep out iron, lead, arsenic, and other metals. The liquid is drawn off, and then precipitated by a solution of sulphide of barium; the precipitate is dried, calcined, raked while hot into cold water, dried again, ground, &c. It then consists of sulphide of zinc, oxide of zinc, and sulphate of baryta, with minute quantities of iron, lead, arsenic, manganese, &c.

The manner in which I have obtained the oxide and sulphide of actinium from this pigment, is as follows, and the process will doubtless serve for the treatment of other substances in which the presence of the new metal may be detected:—

About 15 grms. of finely-pulverised pigment are left for twenty-four hours in dilute acetic acid (strongest acetic acid and water, equal parts), and the mixture well stirred or shaken occasionally. This takes out most of the iron, manganese, magnesia, lime, and oxide of zinc. The residue, after being washed, is treated exactly in the same manner with dilute hydrochloric acid (acid 8 parts, water 92 parts), with the object of completing the action of the acetic acid. The residue, well washed, is then treated with strong hydrochloric acid, to which a little nitric acid is added from time to time. The solution of the chlorides thus obtained is filtered to separate free sulphur and the insoluble sulphate of baryta, and remaining sulphur in suspension after filtration being oxidised by a few crystals of chlorate of potash. To this solution of chlorides, somewhat diluted, a considerable excess of caustic soda is added, and the solution heated. The zinc oxide goes into solution, and the white oxide of actinium remains; the latter is received upon a filter, washed, dissolved in hydrochloric acid, and the solution again treated with excess of caustic soda (these operations may be repeated two or three times, in order to eliminate the zinc oxide as much as possible). Finally, the oxide of actinium, still impure, is washed on a filter, and dissolved in a considerable excess of hydrochloric acid. The solution is neutralised by ammonia, and then the latter is added in excess. All but a little iron oxide remains dissolved (if not, dissolve again in HCl, and add ammonia in excess, which this time will only precipitate the iron). The iron oxide is separated by the filter, and to the filtrate sulphide of ammonia is added, which throws down the sulphide of actinium as a bulky, pale, canary-yellow precipitate, the colour of which is best seen when it is received on a filter.

Oxide of Actinium.—The hydrate, as precipitated by soda or ammonia, forms a bulky white precipitate, more gelatinous than oxide of zinc; unlike the latter, it is only very slightly soluble in caustic soda, even when the liquid is heated; it is not precipitated by ammonia from solutions containing ammoniacal salts. It is a permanent white, with a slight tinge of salmon colour when seen in bulk, and it does not change colour when exposed to the air, as oxide of manganese does, neither does it appear to be affected by the direct rays of the sun. It is readily soluble in acid. The anhydrous oxide is not volatile nor decomposed by heat. It has a pale, fawn-coloured tint.

Sulphide of Actinium.—The hydrate, as precipitated from its neutral or alkaline solutions by sulphide of ammonium, is a bulky pale canary-yellow precipitate, insoluble in excess of sulphide of ammonia, scarcely at all soluble in acetic acid, readily soluble in mineral acids, even when they are diluted. When exposed to the direct rays of the sun, it darkens and becomes quite black in twenty minutes, except in those places where it is protected by a piece of ordinary window glass.

The amount of actinium sulphide obtained from the white pigment amounts to no less than about 4 per cent. This yield is enormous. The presence of this new element in zinc will probably account for the discrepancies noticed in the equivalent of this metal, as determined by various observers. The new element differs very essentially from manganese, zinc, and cadmium, but has, perhaps, some points of similarity with lanthanum. It exists, evidently, in considerable quantities, in at least some kinds of commercial zinc.

FOSSILS IN METEORIC STONES.

THE question whether life exists, or ever has existed, in any the celestial bodies, under conditions similar to those which prevail upon the earth, has been one of deep interest ever since astronomy in modern times dissipated the old theories and set up correct ideas in regard to the solar system. It has been, however, a mere matter of affirmative belief, without any sort of proof to give it a foundation. It has been quite rationally argued that the All-Wise Father of the Universe would not allow such vast worlds, as we are now certain the heavenly bodies are, to remain waste places, without making them the abodes of life. Such was one of the sublime ideas of Thomas Dick, the famous "Christian Philosopher." And some of the materialistic evolutionists of more recent times, who exclude every idea of special creation from their doctrines, have suggested that possibly "in the beginning" life originated upon this earth in one or more germs which fell from some of the circling orbs above us, coming down with or upon those meteoric stones. But aside from the fact that science has shown a strong analogy between the physical conditions of our earth and some of the planets, there has not been until now any other proof of the existence of life as it is manifested to us outside of our own earth. But in the *Popular Science Monthly* for November, Mr. Francis Bingham has a very remarkable and interesting article on the discovery of organic remains in meteoric stones, in which he avers that "we are able to see with our own eyes the veritable remains of animate beings from another celestial body." These stones, which have been falling upon our earth during all historic time, and doubtless from periods far more remote, have been believed by astronomers to be the remains of a planet which had been destroyed in some manner—shattered into fragments by forces which to us may be set down as unknown or mysterious. Two German scientists—Dr. Hahn, a geologist, and Dr. Weinland, a zoologist—have recently investigated

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this subject to some extent, and the result of their labours is that they find in these stones fossil sponges, corals, and crinoids. They are also of the opinion that they have discovered a trace of vegetable remains. The best defined fossils are those of corals and sponges, and in regard to these there would seem to be no doubt. The corals belong to classes which on the earth are found only in some of the oldest geological formations, and they differ from ours in being extremely small. Of the sponges, the remains were in such excellent preservation, that "Dr. Weinland succeeded in actually determining three genera."

"Of one characteristic bluish sponge which occurred in several favourable shavings (into which the stone was cut), both as young and old specimens, he was able to make a drawing of its interior construction as easily as from a living specimen."

These startling discoveries point to the fact that in the world where these rocks and animal forms originated, the course of organic evolution was very similar to that which has taken place upon our earth. But these eminent savants are of the opinion that discoveries will yet be made of organisms for which no place can be found in our systems of zoology. The petrifactions all belong to the subaqueous classes of animals of the lower and more primitive forms, and up to this time no trace has been found of any higher animals, as mollusks, &c.

Dr. Hahn has published a book giving an account of this wonderful discovery, which is illustrated with engravings of more than one hundred specimens of these organic remains, no two of which are alike. These have been reproduced by photography, which does not lie. Further investigations in this new and untrodden field of research will be awaited with the most profound interest.—*Chicago Herald.*

DURATION OF LIFE.

An article lately appeared in the *British Medical Journal* on "Has the duration of Human Life in England increased during the last thirty years?" by Dr. Rabagliati. I have condensed most of it for your readers. From 1838-40, the average death-rate was 22·3 per 1,000; in 1876-9, it was 21 per 1,000; or an average of 44·8 years against 47·6 years; this gives an addition of 2·8 years to each one's life. If our population is 25,798,922 people in Great Britain, then 72,236,981 years of life are added to a generation.

The improvement, he says, is due to better ventilation and drainage, less overcrowding, the destruction of fever dens, &c. This addition, when analysed, shows that infant life is more certain, whilst males above 35, and females above 45 are dying faster than thirty years ago.

Between 1851 and 1878, 360·5 male children under five years died per 1,000; in 1879 only 319·5 per 1,000; this is an addition of 11·4 per cent. to life. If we still compare these dates we find that between 5 and 10 years, 19 per cent. was added; 10 and 15 years it was 24·4 per cent.; 15 and 20 years it was 22·6 per cent.; from 20 to 25 it was 22·6 per cent.; from 25 to 35 years it was 11·3 per cent. In females, comparing same data, it was 14·1, 22·4, 24·4, 25·4, 23·7, 16·7; and from 35 to 45 years there was a saving of 5·8 per cent. in 1879. Males in 1879 from 35 to 45 years died 1·5 per cent. faster than before; 45 to 55 years, 2·6 per cent. faster; 55 to 65 years, 11·9 per cent.; 65 to 75 years, 7·8 per cent., and above 85 years, 7 per cent. faster than from 1851 to 1878. Females between 45 to 55 years 6 or $\frac{6}{10}$ per cent. died faster; from 55 to 65 years, 12·2 per cent.; 65 to 75 years, 11·6 per cent.; 75 to 85 years, 9·5 per cent.; above 85 years, 4·8 per cent. died faster. Examine, then, every 10 years and we find in 1841 to 1850 the death-rate was 22·4 per 1,000; 1851 to 1860 it was 22·2 per 1,000; 1861 to 1870, it was 22·5 per 1,000; and from 1871-9 (nine years) it was 21·5 per 1,000. The improved rate of health has taken place since 1870. Deaths from zymotic (infectious) diseases have lessened; thus from 1850 to 1854 they were at the rate of 5,234 per million living people; 1855 to 1859, they were 5,039 per million; 1860 to 1864, they were 4,899 per million; 1865 to 1869, they were 5,172 per million; 1870 to 1874, they were 4,849 per million; 1875 to 1879, they were 3,911 per million of living beings. From 1850 to 1854 the death-rate was high from these causes; in 1877 to 1879 it was lower from them; but from other causes it was higher than from 1850 to 1854, minus these. Thus it seems that in those days the people were healthier than our present race—it was a case of survival of the fittest, the weakly ones then died and so increased infant mortality; now the weaker ones live, and die soon after manhood, and swell its mortality, instead. The diseases that attack young lives are also becoming less fatal, such as scrofula and consumption, whilst diseases of more advanced life are, on the other hand, increasing in fatality, such as cancer. This reads us a terrible lesson, and one to which everyone's attention should be drawn, for we undoubtedly hold our lives in our own hands; so it depends with ourselves, in a great measure, whether we die at 35 or 75 years.

T. R. Allinson, L.R.C.P.

KNOWLEDGE FOR THE YOUNG.*

An idea seems to prevail that the best way to make knowledge palatable to the young, or to beginners generally, is to dilute it: if a reader finds one fact in a page he can digest it, and better still if he finds one fact in half-a-dozen pages. Then, again, many imagine that knowledge must be sweetened to suit the taste of young folks: we must be poetical and use flowery language, or they will turn from knowledge in disgust. We believe all this (we may say we know it) to be entirely erroneous. If it were true, the book before us would be utterly unsuited for young people; but, as a matter of fact, it is just the sort of book they want. There is no poetry, no flowery language, no attempt to interest by fine talking; and yet the book is full of interest from cover to cover, and full of poetry, too, for those who can read between the lines. Take the opening words. "Coal.—When wood or woody matter such as roots, bark, leaves, moss, peat, and so on, lies buried in the earth for a very long time, it changes into coal. Wherever coal is now found, there were once forests, or woods, or peat, or else mouths of rivers or other places where plants grew, or their dead parts, or leaves, or branches, and roots got heaped together. Then such places get covered with water, often because they sank below the level of the sea, and the sea covered them, and they were at the bottom of the sea. Then the mud which rivers bring down to the sea sank down and covered them, and the shells and skeletons of dead sea animals fell also upon them, so that they got covered deeper and deeper." Then the later stages of coal formation are described, without a wasted sentence. And at the foot of the second page the coal has been followed to ashes, cinders, coke, and breeze (broken up coke), and so the first chapter ends.

How much more sensible this than a page or two of pretty talk about the cheerful blaze of our home fires, the comforting warmth of stoves, and so forth, followed by vague mention of the work coal does in manufacture, &c., with then, perhaps, a reference to the forest primeval, and poetical picturings of the work done by river and sea. We have before us a work, on another subject, in which just such a course is followed. Six pages are employed in saying what might very well be said in half a page, and then the author has the face to say, "let us recapitulate",—the reader being all the while treated as a child might be to whom a bitter medicine was to be given in a spoonful of sweetstuff.

Now, children as a rule (though elementary books are best written when not specially meant for children) care very little for poetical descriptions, and a great deal for facts. They often find a good deal of poetry *in* the facts; indeed, we can imagine few better lessons for those who want to put poetry into their science books than to tell their facts to a bright child, and to listen to its comments. If you want thoroughly to interest a child you must not dilute, but condense. An intelligent child's digestive capacity for information is greater (not less, as many fondly imagine) than that of most grown persons. The usual way of treating readers of "first books" is as unwise as would be the use of baby food for growing boys.

Let parents try the experiment. Give a boy a so-called scientific book full of poetry and platitudes, with the science disguised out of all knowledge, and note how he will weary of it. Then give him such a book as Professor Guthrie's "First Book of Knowledge," and see how much the lad will prefer good meat to pap. Some reviewers criticise such books as this on the score of what they call a common-place style, not knowing that the true eloquence of the scientific writer resides in clearness and plainness of speech. So judged, Professor Guthrie's style is excellent.

The subjects dealt with in this capital book are classed under the following heads:—"Things and Stuffs used for House-building, The Elements, Wood, Heating and Lighting, Finishing and Furnishing (of houses), Clothing, Food, Cleaning, Writing, and Printing." There are questions at the end of each chapter, but we believe that what is learned for question-answering is not properly learned at all. A clever boy should take such a book as this for the mere pleasure of satisfying the mental craving (natural in all healthy minds) for information,—which is the mind's plain food.

* "The First Book of Knowledge." By Frederick Guthrie, F.R.S. (Marcus Ward & Co., London.)

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

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**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

Our Correspondence Columns.

A PRETTY GEOMETRICAL PROBLEM.—FOX AND GUNS.—INTELLIGENT DOG.—FOUR FOURS.—MISSING LINKS.—THE MAGIC WHEEL.—FUNGI AND LICHENS.—FLESH FOOD.—URSA MAJOR, VENUS, AND THE NORTH POLE.

[184].—"Student" gives the following puzzle, to which he says there are twenty-five solutions; but there are really many more. We withhold his solution:—

Take a square piece of paper, and remove from it a corner square (equal to one-fourth of it), leaving three small squares in one piece. It is required to divide this three-square piece so that the parts can be put together to form a single square.

At the same time we submit the following puzzle, sent us by "Mogul," who promised, but did not send, a solution:—

Given any rectangle, to divide it by the fewest possible straight cuts, so that the parts can be put together to form a square.

J. Rae points out that from the way in which the string is fastened, which Mr. Henslow considered a fox might pull "out of the line of fire," our interpretation of these words (letter 158, p. 187), cannot be correct. The fox would inevitably be in the line of fire in touching the string; and in the condition in which the string usually is, would run great risk. Such a fox would "do a most foolish thing, as foolish as a sportsman who should drag his gun on full cock by the muzzle through a hedge."

The Rev. J. P. Sandlands describes how a strange dog stopped him in Westbourne-park, until he responded to the appeal in the dog's eyes that a gate leading to the dog's master's house should be opened.

E. Clarkson, Geo. D. Brown, J. A. Miles, Nemo, F. J. J., and others, give solutions of the four fours, for numbers from 1 to 20 inclusive, except 19. Other problem, Yarletoman gives for 19 the formulæ.

$$(+)\ \frac{4}{\cdot 4} + \frac{4}{\cdot 4} \text{ and } \times \frac{\lfloor 4}{} - 4 - \frac{4}{4}$$

F. J. J. gives $\frac{4}{\sqrt{\cdot 4}} - \frac{4}{4}$

which is manifestly erroneous. E. Clarkson and F. G. Hooton give for 19, $\frac{4 + 4 - \cdot 4}{\cdot 4}$ J. Bosworth points out that four 3's will give the same numbers as three 5's (except for number 17); and that 19 may be given for any number whatever by the formula $\frac{x + x - \cdot x}{\cdot x} = 19$. It seems to me that as "Amicus Scientiæ" gives, like the others, for 11, the formula

$$\frac{44}{\sqrt{4} + \sqrt{4}}$$

in which the first 4 in numerator really stands for ten times 4, ·4, which stands for 4 divided by 10, is admissible for 19. Otherwise 11, as well as 19, must be regarded as insoluble. The solutions given by "Amicus Scientiæ" are as follows:—

No. 1.	$\frac{44}{44}$
2.	$\frac{4}{4} + \frac{4}{4}$
3.	$\frac{4+4+4}{4}$
4.	$4+4-(\sqrt{4}+\sqrt{4})$
5.	$\frac{4\times4+4}{4}$
6.	$\frac{4+4+4}{\sqrt{4}}$
7.	$\frac{4\times4-\sqrt{4}}{\sqrt{4}}$
8.	$\frac{(4+4)\times4}{4}$
9.	$\frac{(4\times4)+\sqrt{4}}{\sqrt{4}}$
10.	$4+4+4-\sqrt{4}$
No. 11.	$\frac{44}{\sqrt{4}+\sqrt{4}}$
12.	$4\times4-(\sqrt{4}+\sqrt{4})$
13.	$\frac{44}{4}+\sqrt{4}$
14.	$4\times4-(4\div\sqrt{4})$
15.	$\frac{44}{4}+4$
16.	$4+4+4+4$
17.	$4\times4+\frac{4}{4}$
18.	$(4\times4+4)-\sqrt{4}$
19.	
20.	$4\times4+(\sqrt{4}+\sqrt{4})$

"Another Ignoramus" writes that the argument of the evolutionists is not strengthened by showing that there are many missing links. He supposes Prof. Wilson "would have us believe that man is connected with some anomalous creature which exists only in his own imagination." Dr. Wilson holds in reality, as every evolutionist holds, that man is related to the Simians; and it is not a mere fancy, but an obvious common sense deduction from what is known about evolution, that the Simians must have changed from the common ancestor as much as man as changed; so that since man differs widely from all Simians, however obviously related to them, both man and Simian must differ widely from the common ancestor of both. "Another Ignoramus" seems to overlook the circumstance that no one has called him an ignoramus but himself. At the close of his letter he says he can see no reason why we should cease to admire the wisdom of God in creation. Neither does any one else. What the evolutionists really say is that we do not quite so thoroughly understand that wisdom as men formerly thought they did. Instead of a finite, and therefore possibly intelligible plan, we find a plan which is infinite alike in time and space, and therefore for us absolutely unintelligible. We can follow its workings over an ever widening domain, but, with the widening of this domain, the domain around, which may be regarded as that of the unexplained, is ever enlarging. Man in the past may be compared to a child, who, having been in ignorance up to a certain age of all the laws of nature, all which constitutes what we call knowledge, should have been told that everything had been fashioned just as he sees it, in a moment of time, out of nothing. If such a child, observing what takes place around him, should gradually learn something of the operation of the simpler laws of nature, he might imagine in his ignorance that they implied, not the operation of a Being living in and through all things, but the blind action of mere matter. Or if, instead of observing these things himself, he was simply told about them by others, he might wish to close his ears and his eyes, lest he should "cease to admire the wisdom of God in creation." The fear would be very idle and foolish, we know. Even the opponents of evolution must see that. But they act in this way themselves, and expect to be regarded as exceptionally devout admirers of the wisdom of God, because they would limit His domain in time, and narrow it in space.

C. H. Wingfield points out that by having eleven slits (at equal distances) instead of ten, the horses round the magic wheel seem not only to move their limbs but to advance. Certainly with the same number of slits as horses, the horse presents a somewhat singular appearance, flourishing his legs about, but not getting over the ground. In *La Nature* the picture in the *Scientific American* is given without change, viz., twelve figures of the trotting-horse, the uppermost of our view and the one next to it on the left being given twice over. We have tried the magic wheel with this arrangement, and find that the horse seems to trot with a singular extra kick once in each double stride. We have not yet tried Mr. Wingfield's plan, but have no doubt it would act as he says.

E. C. Cowley desires to learn Mr. English's address from Mr. W. W. Highbury, and to know in what sense the "subscription list is open" to any one desiring a copy of the book.

"A Fellow of the Chemical Society" points out that if it can be shown, as he believes Mrs. Kingsford has shown, that man in physical formation is nearest to the apes and in striking contrast to the flesh-eaters, the natural food of man must be that which we find apes eating. Might one not argue, almost as effectively, that men should limit their pursuits to those which satisfy their Simian cousins? I do not say men might not live, and thrive, and work, and think, on a diet of nuts, fruits, and vegetables, or that they do not, as a rule, eat much more flesh than is good for them; but we must not adopt a false system of reasoning even to establish the truth. "F. C. S." states what is more to the point, that many who

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have suffered from dyspepsia when living on mixed food, have been freed from the malady after (and presumably on account of) a change to a vegetable diet. I wish there were space for his letter in full, but there is not.

"A. G. P." has seen parts of Ursa Major in lat. 20° south, and a shadow thrown by objects in light of Venus. He asks what phenomena beyond total absence of centrifugal force might reasonably be expected at the pole? Extreme cold, we should say, the pole of the heavens over head, sun visible for more than half a year and invisible for the rest of the time. Richard A. Proctor.

CHEAPENING OF APPARATUS, AS AN AID TO THE DIFFUSION OF SCIENTIFIC KNOWLEDGE.

[185]—At the beginning of a New Year, I venture to suggest that the most worthy and laudable end to which Knowledge so especially addresses itself—that of the diffusion of sound popular scientific information—might be very considerably advanced by that invaluable class of men, the optical and philosophical instrument makers, if they would only address themselves to the production of apparatus at a cost to bring it within the means of those whose pecuniary means are (like the joint-stock companies) "limited." Conducting some experiments in chromatics recently, I required a double-image prism, for the purpose of superposing coloured discs; but on a friend inquiring on my behalf at two separate shops, he was asked 12s. 6d. for one at one of them, and 15s. at the other! Now, we know pretty well what Iceland spar costs in the rough, and I feel tolerably confident that a prism mounted in a simple bit of brass tubing might be sold at a good profit for half-a-crown. Such, though, is the trade conservatism among those concerned in the manufacture of such things, that they would much rather sell one prism at 15s. than eight for a sovereign. *Mutatis mutandis*, these remarks would equally apply to the transit instrument. There can be no doubt that a real want exists for a simple meridian instrument, which shall be at once trustworthy to use and cheap to buy; but £45 represents the present price of the smallest transit made which is really serviceable. Here, then, is an opening for some enterprising scientific artificer, at once to benefit himself and the community at large. An economical transit instrument once produced, it may be worth the while of clock and chronometer makers to try whether a cheap compensated sidereal clock is quite an impossible thing to construct? The achromatic telescope has been cheapened, and a really efficient photographic camera can now be bought for a small sum. In other types and classes of instruments, however, the opticians are content *stare super vias antiquas*. It is in hopes of rousing a few of the more energetic among them to a course of action which must ultimately benefit them as much as it undoubtedly must the great army of scientific students in this country, that these lines are written.

A Fellow of the Royal Astronomical Society.

INSTRUMENT FOR DESCRIBING THE CONIC SECTIONS.

[186]—In answer to "F. R. H. S.," I may say that in Fig. 2 (p. 160) the central leg of the instrument is held at an angle corresponding with the amount of eccentricity of the intended ellipse, while the moving leg slides up and down the same, thus describing a section of a cylinder.

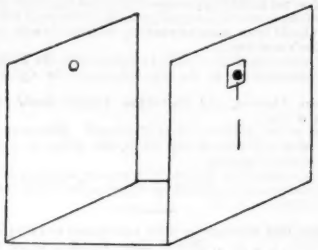
As to Fig. 1, the idea was suggested by the shadow of the upper part of the globe on the gas bracket, cast by the glimmer of light usually left in, on the walls of my bedroom, the style shown moving round a circle simply performing the part played by the rays of light. Thomas Thorp.

A LUNAR ILLUSION.

[187]—"S. H. W." will perceive, on reconsideration, that he has made a mistake in his letter, No. 64, with the above title. The illusion mentioned is only an illusion, and it is solely connected with the projections of the moon and sun on the sphere of vision, which may have any radius we choose to give it, and not with their unequal distances from the eye. In the case supposed by him, viz., when the moon is in the zenith, there will be no illusion; the observer would naturally stand facing the sun, and he would look "square" at both moon and sun, and be able to produce the sagitta correctly, by the eye, to hit the sun. "S. H. W." seems to be thinking of the plane containing his eye and both luminaries; he is thinking, too, of the sun itself, and not of its above projection. The sagitta never points to the sun itself, except at half-moon. If we knew the angle between the sagitta and the line joining the moon and the sun itself, and observed the angular distance of those two luminaries, we could get their proportional linear distances from the earth. But we can never see that angle, since we are in the plane of it; we know, however, its value at half-moon, viz., zero; but we cannot tell, by the eye, any better than Aristarchus, when it *is* half-moon precisely, and therefore should fail, as he did, to get the relative distances of moon and sun. M.

OPTICAL ILLUSION.

[188]—Take a strip of thin card about three inches long and one wide, bend up the ends at right angles, perforate one end with a pin-hole and the other directly and concentrically opposite with a square hole about one-eighth of an inch square; place a small pin in



From *Nature*, vol. xxiv., p. 53, 54.

this end, so that the head may be in the middle of the square hole; apply your eye to this end, and look through both holes towards the sky, and the pin will be seen apparently beyond the pin-hole and reversed in position. A. T. C.

THE FIFTEEN PUZZLE.

[189]—If we are allowed to turn the board we can pass from the lost to the won position in thirty-nine moves.

For instance, we may move the pieces numbered 12, 8, 4, 3, 2, 1, 5, 9, 13, 15, 14, 12, 8, 4, 3, 2, 1, 5, 9, 13, 10, 14, 12, 8, 4, 3, 2, 1, 5, 9, 13, 10, 14, 11, 7, 6, 10, 14, 15.

There is no solution in less than thirty-nine moves, for thirty-seven moves are needed to move the blocks by the shortest paths from their first to last places; and the other two moves are needed because the four blocks in the middle cannot move round until one of them steps out into the outer row, from which it must again return.

I gave the above solution and proof in the *Brighton Herald* in May, 1880.—Yours, &c. Arthur Black.

J. Watson gives a similar solution, thus:—4.8.12.R.—12.3.U.—5.9.13.L.—12.14.15.D.—3.4.8.R.—1.2.U.—6.10.14.L.—8.12.D.—2.3.4.R.—5.6.1.U.—9.13.L.—11.14.D.—6.7.R.—9.5.U.—13.14.15.L.

PNEUMATIC BELL.

[190]—The pneumatic bells referred to by me (letter 79, p. 100) were supplied and fixed in my house for me by a firm at King's-cross, where "E. R. C." can obtain every information. I could not instruct in the manufacture of the article. Although the fixing of the three requisites, viz. (1) pipe, (2) press-button, and (3) bell, is very easy, yet space in Knowledge is, I apprehend, too valuable for such detail as gas-fitter's work. All I can say and assure "E. R. C." of is this—a more simple, reliable, cheap, and instant signal, produced only by compression of the air we breathe, cannot possibly be obtained.—Yours truly, M. Tester.

P.S. I am sorry to say I could not procure Knowledge at the bookstalls of Birmingham or Lichfield, where I have been staying the last fortnight, so I have not seen the recent issues until my return to London.

INFLUENCE OF SEX ON MIND.

III. Historical Evidence.

[191]—History is conclusive as to man's mental supremacy. The inventing, creating, cogitating mind is masculine. Men carry on the world's business in thought and action. The ideas on which depend all the marvellous acts of human intelligence, scientific discoveries, jurisprudence, political, civil, military institutions, maintaining the social structure, are elaborated by men. In the domain of pure intellect it is doubtful if women have contributed one profound original idea of any permanent value. Men legislate, govern, invent, colonise, fight, build, and dig. So little demand is there for woman's *direct* help in the mental departments which are men's special province, that, could all the male intellect in the world be suddenly paralysed or annihilated, there is not in woman

sufficient development of the abstract principles of justice, morality, truth, causality, inventive, and executive power to hold society together for one week.

"In matters intellectual and moral the long strain beats them dead. Do not look for a Bacona, a Newtona, a Handella, a Victoria Huga. American ladies tell us education has stopped the growth of these. No; these are not in nature. They can bubble letters in ten minutes which you could no more deliver than a river can play like a fountain. They can sparkle gems of stories, flash little diamonds of poems. The entire sex has never produced one opera or one epic that mankind could tolerate for a minute—and why? These come from long, high-strung labour." (Mr. Charles Reade, in "White Lies.")

Women lack the highest quality of the human mind—*justice!* They never see two sides of a question. A woman makes a firm friend—a dangerous enemy.

The eternal subordination of woman is conclusively exemplified in her exaggerated admiration for the male prerogatives—strength and intellect. Were intellectual sexual equality not an idle dream, it would long ago have produced practical results. The strong-minded woman would have proved her pretensions. Woman's individuality and independent action in important matters are more apparent than real. Savage life shows the nearest approach to sexual equality, physical, mental, and moral. Yet among savages woman is a slave! In civilised countries, where she is free, almost every woman is steered through life by the reflecting brain, strong will, and protecting arm of a husband, father, brother, or son. A woman with no male relative has her spiritual director, her confessor, or favourite preacher, her conscience-keeper, whom she regards as a superior being. Even revolutionary women are guided by men. Platform ladies worshipped Mr. J. S. Mill. They could not understand his works on Political Economy and Metaphysics, but he advocated Woman-Suffrage! If there is one woman without such a director, she is guided by male public opinion, supplemented by oracles uttered by men in the past.

Mentally, morally, and physically woman is subordinate to man; although the meek idolator sometimes adores a brazen god!

J. MCGRIGOR ALLAN.

POSSIBLE VARIATION OF PENDULUM.

[192]—A letter from "Cogito" in KNOWLEDGE (No. 8, p. 143) refers to mine (in No. 6, p. 88). He speaks of "want of precision of ideas;" true, I am alluding to a stationary pendulum; he is speaking of a vibrating pendulum.

The point is this: suppose a pendulum suspended in a railway carriage. On the train starting, motion must be communicated to the bob through the rod, and the pendulum will be thrown out of the perpendicular backwards; on slackening, the bob will be thrown forwards, momentum having been given and then withdrawn. The motion of the earth round the sun in the short space of twelve hours may be considered as in a straight line, *a b*, the centre of the earth, travelling uniformly *a* to *b*, but the sides nearest to and furthest from the sun will travel, the one 1,000 miles faster, the other 1,000 miles slower (as the upper and lower points of a carriage wheel). The velocity of the bob in the direction *a b* will, therefore, vary 2,000 miles per hour between midday and midnight, the acceleration and retardation being communicated from the point of suspension through the rod to the bob. If this action were rapid, the effect would be evident enough, the difference of velocity being great, but the time is long, and in consequence the movement of the bob would no doubt be extremely small. The question is, would it, with a rod say of 100 ft. in length, be perceptible under suitable delicate measurement?

HENRY CARR.

RATTLESNAKES.

[193].—You enjoy one great advantage over me. You are like a priest in a pulpit, who from his elevated post can, with impunity, hurl his censures on the devoted heads of obscure sinners like me, who occupy the low free seats, and are debarred from saying a word in our own defence publicly.

Mr. Darwin's discourse on the rattlesnake is to be found at pages 107—110, in his book on "Expression," &c. (first edition). I maintain that the passage is susceptible of the meaning I attached to it; for if your explanation is correct, viz., that Darwin attributes "the habit of the snake to its development,"—[We did not say this. "Rather," we said, "he would," &c.—ED.]—then we are landed in the poor, paltry platitude, that when an animal possesses an organ, the creature makes use of it. Most wonderful, truly! But surely it was hardly worth while to write three pages of "information" to establish such an obvious, vapid circumstance—such a feeble inanity.

The cause and mode of developing the rattle are, however, a secondary consideration in comparison with the use to which the snake is said to devote its organ, when it is found, viz., "to frighten its enemies." I contend that the means of accomplishing the assigned purpose are simply suicidal, and that the noise of the rattle attracts the snake's enemies who seek its destruction.

I have read somewhere that in America, when the workmen in the woods hear the rattle they are sure there is no danger, but directly the sound ceases they infer that the snake is bent on mischief. So here it is not the noise of the rattle, but its silence, which is a source of alarm.

You are quite right in thinking that Mr. Darwin has never done me any injury. On the contrary, I believe him to be an estimable man, and incapable of injuring any one intentionally; but his writings appear to me to be a great offence to the Creator, to Nature, and to common sense, and therefore that his productions ought to be denounced. They have also set an example of a lax scientific method. In your own columns, at page 153, a disciple of Darwin's writes in this style on the origin of the grape:—"*Suppose*, however, that any plant *happens* to have its seeds covered with a moderately hard and indigestible coat," &c. And again: "If such a tendency were ever to be *set up* even to the slightest degree by a *mere sport* or *chance* variation," &c.

I venture to think that we shall never properly comprehend God's works in all their might and majesty of original design while we deal with them in such a puerile fashion; and with this sentiment I now respectfully take my leave of you.

NEWTON CROSLAND.

[We insert this letter, though doing so is, we fear, rather hard on Mr. Crosland.—ED.]

LONGEVITY IN ANIMALS.

[194]—In your article on "Food and its Relation to Muscular Work," you only appear to treat with what I would call active beings. I should like to know what you have to say about inactive animals, such as turtles and tortoises. I presume to call them inactive on account of their sluggishness and their dormancy. It is a well-known fact that they will live a long time without having partaken of any visible means of sustenance. I have known turtles to live without food for weeks out of their own element. A wrong idea exists with a good many people as regards the heart of a turtle. Many do believe that they have three hearts. I have examined the heart of a turtle, and I have come to the conclusion that what is taken to be three hearts is but one externally divided into three parts, not like the human heart, which is divided into four, and then encased in a membrane, called a pericardium. Can you tell me if I am right? The late Frank Buckland, when looking at the turtles in the tank at the Adelphi Hotel, Liverpool, supposed they live on the water they take in, then on their fat and blood. How is it they live a long time without water and pass urine? If any of your readers can explain, it would be cordially received by those readers physiologically inclined.—Yours most respectfully,

PHYSIO.

TOADS, &c.

[195]—In reference to query 87, and the doubts expressed as to the existence of toads in rocks of an earlier than the tertiary formation, it is an acknowledged fact amongst miners that toads have been extracted living from the solid coal, at various depths. I heard of one found two months ago in a pit 400 yards deep, near Oldham, where the coal, with the hole where the toad had been imprisoned for countless ages, was preserved, and the toad, although alive when reached, died on being exposed to the atmosphere. If "A Fellow of the Royal Astronomical Society" will make inquiries of scientific men in that district, he will learn the whole truth.

I have heard miners relate the extraction of one from the Lanarkshire coalfield, which was heard croaking before it could be liberated, and so frightened the working colliers that they fled, and would not return without the manager was present, and under these conditions the toad was hewn out, in the presence of several witnesses. Although it was rolled carefully in a wet cloth, it died before it could be taken out of the mine. It was deposited in a local museum, and no one dared to contradict the fact at that time.

ZARES.

[196]—I am only an inquirer without time or means for systematic observance, but I am interested in the query of "Arachenda" (87), and submit that I was disappointed in "A Fellow of the Royal Astronomical Society's" treatment of it (138), page 165, which must be my apology for troubling you with the copy of "cutting" from my scrap-book herewith enclosed.

A tradesman at Bromley, Kent, observed me examining flint pebbles which abound in that district and volunteered the statement, that on breaking a similar one to that I held in my hand, a

XUM

live toad hopped out, not very long ago. No allusion had been made to anything of the kind previously, and he could have had no motive for saying what was untrue.

I presume these fossiliferous flints in "the crag" are well known, although I find no particular notice of them in geological works in my possession; but considering the cells in them and the channels by which they are approached from outside, is it possible for a new tenant to be inducted and developed such as the toad?

If Sir W. Thomson could speak seriously of a Colorado beetle surviving a voyage through space in a meteoric stone (see report of British Association Meeting at Plymouth, 1877—Mathematical and Physical Section), I hope you will pardon me if I have strained a point on the capabilities of a toad.—Yours, &c., W. B.

"A Curious Fact.—Many years ago a friend of my father's built a country house, which he fitted up and furnished according to his own taste; to accomplish this he caused to be brought from Italy a piece of pure white marble, out of which a mantelpiece was constructed for his own particular sitting-room. The mantelpiece was of singularly pure marble, in one block, and free from flaw, save in one part. Shortly after its erection, the owner of the house noticed a small damp-looking stain, no bigger than the nail of his little finger in the very centre of the mantelpiece. This, however, was so slight a blemish that it did not trouble him, till, as months and years went by, it became evident that the mark slowly but surely increased in size. For twenty years the good man of the house sat in his arm-chair facing the curious stain and marvelling what caused its certain spread. At the lapse of that period it had increased to the size of the palm of his hand, and he could no longer rest in patient contemplation of it. Masons were sent for and desired to take down the marble and break it in two, so as to disclose the mystery. This was done, and to the amazement of all, out hopped an enormous toad!"—"H. A. F.," in *Chatterbox*.

INTEREST ON A FARTHING.—AN APPLICATION OF LOGARITHMS.

[197]—As the nature of compound interest is little understood by many, we will assume that a farthing was placed out, at compound interest at 5 per cent., payable yearly, commencing at the Birth of Christ, and extending over time till the end of the year 1880. Now, the mean diameter of the planet Jupiter is 88,645 miles; the weight of a cubic foot of pure gold equals 17,486 oz.; and the value of the gold being at the rate of £3. 18s. per ounce; how many globes of pure gold, each as large as Jupiter, would that interest purchase?

The principal and interest of £1 for one year	1·05 log.	0·021189
Multiply by the years		1880
		1695120
		169512
		21189
Raised to the 1880th power		39·835320
Subtract the log. of the farthings in a £.	960	2·982271
Log. of the amount of interest for the given time, equals	7129+	36·853049

7129+ (thirty-three more figures).

Diameter of Jupiter in miles	88645 log.	4·947654
Feet in a mile equals (1760 × 3)	5280 „	3·722634
Feet in Jupiter's diameter		8·670288
Raise this quantity to the 3rd power		3
The diameter raised to the 3rd power		26·010864
Add the log. of ¼· (3·1416)	·5236 „	·1·719000
Solid contents of Jupiter		25·729864
Weight of a cubic foot of gold in oz.	17486 „	·4·242680
Value of one ounce of this gold, £3. 18/.	3·9	·0·591065
Value of a solid globe similar to Jupiter equals	3661+	30.563609

3661+ (twenty-six figures)

Amount of Interest (Log.)	36·853049
Value of Jupiter	30·563609
Log. 1947331 =	6·289440

It therefore appears that the interest upon a farthing for 1,880 years, at 5 per cent., would purchase 1,947,331 solid globes of pure gold, each as large as the planet Jupiter.—Yours, &c., Pascal.

[The calculation is a pretty illustration of the value of logarithms. The mean diameter of Jupiter is much less than 88,000 miles, so that the legal representatives of the original owner of the farthing can claim from the bankers with whom that farthing was placed at interest, a much greater number of gold Jupiters. But that is a detail.—Ed.]

THE HOG PUZZLE.

[198]—The following problem may serve to amuse some of the many young readers of Knowledge who are conversant with the elements of Algebra. It was given me by a young lady, but the analysis is my own.

Question.—Three Dutchmen, Hendrick, Elas, and Cornelius, and their wives, Gurtrün, Katrün, and Anna, purchase hogs. Each buys as many as he (or she) gives shillings for one. Each husband pays altogether three guineas more than his wife. Hendrick buys 23 more hogs than Katrün, and Elas 11 more than Gurtrün. Require the name of each man's wife?

I call this a "puzzle," because I venture to think that nineteen out of twenty would attempt its solution by the common process of simultaneous equations, and would certainly fail, because there are more unknown quantities than the number of independent equations it is possible to construct. The solution is, however, obtained in a very simple manner, thus*:—

For brevity, denote the men and women by their initials H, E, C, G, K, A, and let the corresponding small letters h, e, c, g, k, a, represent the number of hogs (equal to the payment for one) purchased by each respectively.

Then h^2, e^2, c^2, g^2, k^2, a^2 are the sums expended by each.

Thus H purchases h hogs for h^2 shillings; E, e hogs for e^2 shillings, &c. Also 3 guineas = 63 shillings.

Observe (1) that h, e, c, g, k, a must be positive integers; and (2) that if m and n are any positive integers, such that

$$m^2 - n^2 = 63$$

or $(m+n)(m-n) = 9 \times 7 = 21 \times 3 = 63 \times 1$,

there are three, and only three, possible values of $m+n$ corresponding to three of $m-n$.

If $m+n=9$, $m-n=7$, which gives $m=8$, $n=1$
„ $m+n=21$, $m-n=3$, „ $m=12$, $n=9$
„ $m+n=63$, $m-n=1$, „ $m=32$, $n=31$

Suppose now m to be the price (in shillings) paid for a hog by a man, and n that paid by his wife. It follows that m may have three values, *viz.*, 8, 12, 32, corresponding respectively to three values, 1, 9, 31 of n. Also, since each man is the husband of some woman, and each woman the wife of some man, whatever arrangements may exist between the quantities h, e, c, and g, k, a, each is susceptible of three values. Any one of the quantities, h, e, c, may have a value of m, provided its corresponding quantity in the groups, g, k, a, has the corresponding value of n.

But there are two equations of condition.

$$h - k = 23 \quad \ldots\ldots (1)$$
$$e - g = 11 \quad \ldots\ldots (2)$$

Referring now to the values of m and n, we find that to satisfy
(1) we must have $h=32$, $k=9$;
. . . . . (2) . . . . . $e=12$, $g=1$.
We may infer from this that $c=8$, $a=31$.

But to verify our inference, substitute for h, e, k, g in the general equation

$$h^2 + e^2 + c^2 - (g^2 + k^2 + a^2) = 3 \times 63$$

the values just found, and we have

$$a^2 - c^2 = 897,$$

which can be satisfied with no other possible values of a and c than $a=31$, $c=8$.

Having obtained the number of hogs each man and woman has purchased, we at once observe that—

$h^2 - a^2 = 63$, and therefore that A is the wife of H,
$e^2 - k^2 = 63$, „ K „ E,
$c^2 - g^2 = 63$, „ G „ C.

Yours, &c., I. R. Campbell.

MOCK SUNS.

[199]—On Monday, Dec. 19, 1881, between two and half-past in the afternoon, on Wandsworth Common, I saw two spectra, irregular in shape, with apparent diameters about twice that of the sun, one on each side of and apparently equidistant from the sun. They were at the same apparent height from the horizon as the sun, and, by guess, appeared to be 25° from the sun. The colour-bands were

* The young reader should try to make out the solution for himself, before reading what follows.

vertical and distinct, the red band being nearest the sun. A band of white light descended from each spectrum half way to the horizon. These bands appeared slightly curved towards one another. The sun was shining through light, ill-defined, massy clouds. FRED. W. FOSTER.

[Distance, theoretically, about 22½° from the sun.—ED.]

SHAPE OF SATURN'S SHADOW.

[200]—Is not the distorted shadow caused by the irregularity in the density of Saturn's rings? I offer this as a suggestion, because I have frequently observed most eccentric forms thrown by a strong light upon mist, totally out of drawing with the object causing the shadow,—Yours, &c., F. YBLES.

[The irregularity of the shadow may be partly due to this cause, but cannot be wholly thus explained, as Mr. Ybles will see if he considers that we see the shadow in nearly the same direction that it is thrown.—ED.]

RING OF LIGHT ROUND MOON.

[201]—Last night (Jan. 1), at 10.5 p.m., I and several others saw a complete ring of light round the moon at a distance from her of about twenty-six moons' diameters. The sky was somewhat hazy at the time, and half-an-hour later was covered with heavy clouds. If you can afford space for an explanation of this fact I shall be much obliged.—Yours, &c., E. W. P.

[What you saw was a lunar halo, caused by the refraction of the lunar rays through ice crystals. You must have considerably under-estimated its apparent distance from the moon, which would be nearer forty-two than twenty-six diameters of the moon.—ED.]

WINDMILL ILLUSION.

Referring to the letter 161, p. 187, I dare say you will remember, at Cambridge, another "illusion," whose discovery was ascribed to Dr. Whewell—viz., look from a point about a quarter of a mile distant, edgeways, at the sails of a windmill in rotation, and you can make them go whichever way you please. THOS. S. BAZLEY.

[So also, if any one at some like distance whirls round a ball attached to a string, the plane of the ball's motion being aslant, so that the ball seems to describe an ellipse, it is difficult to tell which way the ball is travelling, when the distance prevents us from seeing whether it passes on the nearer or farther side of the swinger, when lowest.—ED.]

RICHTER'S DREAM.

[202]—When lecturing at Sheffield in connection with the Gilchrist Fund, you, on two occasions, concluded your lectures with a splendid recitation about an angel taking a man through the realms of space. Will you kindly inform me who is the author of the poem, where I can obtain it, and—if it be not asking too much—the price? I have been told it is one of Jean Paul Richter's "Rhapsodies," and have ordered it at my booksellers, but he could not obtain it for me, though he tried for several weeks. I suppose you would consider it too long to find a place in KNOWLEDGE.—J. W. STANIFORTH.—[It is given in my book, "The Stars and the Universe" (Longmans), also in Mitchell's "Stellar and Planetary Worlds."—ED.]

POPULAR FALLACIES.

[203]—The letter of your correspondent "N." (No. 136, page 188) affords the opportunity of suggesting that KNOWLEDGE might advantageously publish an article or two on "Popular Fallacies," with a view to the destruction of some of the many time-honoured but baseless notions which, handed down from generation to generation, even amongst the fairly educated classes, are accepted without investigation, and believed in with the firmest faith. As examples, I might point to the common practice of placing the poker cunningly over a dull or dying fire, with the idea that "it will draw it up," to the frequently expressed belief in the maleficent influence exercised by the moon when "lying on its back" (whatever that may mean) on the weather, &c.

In the meantime, however, let me advise "N.'s" housemaid to bestow as much care on her fire when the sun shines as when the day is dark and cold, and she need not then fear its going out. I am a pretty regular smoker myself, but I have never yet observed my cigar manifest a greater tendency to go out in sunshine than in cloud.

I suppose that the notion of the sun putting the fire out has arisen from the fact that the brilliancy of the sun's rays overpowers the feeble light of the fire. Let "N." light an ordinary spirit lamp in the sunshine. He will hardly *see* the flame at all. But if he will put his finger where the flame should be, he will, I think, be less inclined to believe that "bright sunlight interferes with ordinary combustion" than he now professes to be.—Yours, &c. WM. H. A.

GHOSTS.

[204]—Referring to your article on this subject (p. 183, Dec. 30, 1881) with an extract from Dr. Wilson's work, may I ask if all the ghosts, of whose appearance we have well authenticated accounts, are to be accounted for on the principle of the "physical derangement" of the person who saw them? How many such accounts we have of persons seeing an individual exactly at the time of his death, though the said individual was miles away at the time, and had not been thought about for years. Lord Brougham, for instance, made an agreement when a young man at college with a friend, that whichever died first should appear to the other, and very many years afterwards was startled by an apparition of his friend, just at the time of his death.—Yours, &c., EBENEZER KELBY.

[205]—Will Professor Andrew Wilson kindly explain how he reconciles the case of the War Office ghost with his disbelief in ghosts? In that case I think three friends in different parts of England saw the deceased officer at the corrected date of his death abroad. T. D.

COMMUNICATION WITH THE MOON.

[206]—I have seen it stated that a French philosopher suggested the possibility of communicating with the inhabitants of the moon, if such there were, by means of mathematical figures, constructed on a very large scale, in some such region as the Desert of Sahara, Siberia, or the like. Can any readers of KNOWLEDGE give me information as to this idea, and the reasoning by which it was supported? X. DAVINE.

[Probably some reader may be able to answer "X. Davine's" question. I have not myself seen the passage he refers to, but believe it was a German, not a French writer, who suggested the idea. [I find a passage in an old number of the *Magasin Pittoresque*, running as follows:—"If the Selenites are beings endowed with reason, men may establish a system of intellectual correspondence with them. In fact, if the arts and sciences are as much advanced among them as they are amongst us, they must often have gazed on the immense globe which shines in their firmament, having an apparent surface sixteen times as great as that of the full moon as we see it. That globe is the earth on which we live. . . . . They can see our rivers, our great lakes, our chief cities. . . . . Thus, some gigantic telegraphic signal might be seen from the moon . . . What signal should be employed? to what language can we have recourse? All the signs by which we translate our thoughts are arbitrary and conventional. . . . . How are we to correspond with beings who, perhaps, have nothing in common with us but intelligence? Yet there is a method—the mathematical sciences furnish it." The writer goes on to show that if the Selenites have succeeded in constructing telescopes to see such signals as we might make, they must have also mastered the first principles of mathematics. Among the fundamental propositions is one due to Pythagoras, called the theorem of the square of the hypothenuse (*théorème du carré de l'hypothénuse*)" (viz., that the square on the longest side of a right-angled triangle is equal to the sum of the squares on the two shorter sides). He shows that if the Selenites are mathematical at all, they must have discovered this truth. "If, then," he proceeds, "we were to construct, as a German geometrician has suggested, a figure illustrating this theorem on a scale large enough to be seen by lunar telescopists, they would understand its meaning, and would probably reply with another figure, or some other signal. Then we should know that inhabitants existed in the moon, and that they were endowed with reason. Once this correspondence was started, who can say where it would end?" Our author says he sees the smile of incredulity on the lips of his readers. The idea must seem to them ridiculous, and none wonder that it had its origin in a German brain. "But do not judge too hastily:" the word impossible is hurtful to human pride; and if communication with beings in other worlds is not impossible, it must be conducted in this way, for there is no other.—ED.]

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Queries.

[162]—INSTRUMENT FOR DESCRIBING ELLIPSE.—On page 160, No. 8, vol. 1, of KNOWLEDGE, Mr. Thomas Thorp gives a design in Fig. 2 of an instrument for describing ellipses. I shall esteem it a favour if he will describe the mechanism of it.—W. G. [It seemed to me clear that the stem of the instrument is intended to be held in a fixed slanting position, while the moveable branch is carried around, sliding at the same time backwards and forwards on the fixed stem. See Mr. Thorp's reply.—ED.]

[163]—SUN AT HIS NEAREST.—At what season of the year are the British Isles nearest the sun?—GEO. D. PATTERSON.—[About Jan. 1, when the sun is nearest to the earth.—ED.]

[164]—NON-ACHROMATIC TELESCOPES.—Would a 3-in. OG non-achromatic telescope be of any use for a beginner, or do the tints very much affect the clearness of the object? Also is there any simple way of overcoming the difficulty?—G. W. L.—[Such a telescope would be of very little use; a very small achromatic—one, perhaps, an inch in diameter—would show much more, and a great deal more conveniently. There is no way of correcting the difficulty.—ED.]

[165]—HORSERADISH.—What are the properties of horseradish, and how does it act on the gastric juice when partaken of?—T. HENERMAN.

[166]—SHORTHAND WRITING.—Can you, or any of the readers of KNOWLEDGE, inform me which is the best system of shorthand? Has there been any system of late years which is thought an improvement on, or is more easily learnt, than Pitman's?—ENQUIRER. [There is no doubt whatever that Pitman's is the best, most easily learnt, and scientific; it is used by all the most skilful stenographers.—ED.]

[167]—STAR CATALOGUES.—Will you kindly favour me with the titles and dates of one or two star catalogues, both of ancient (comparatively) and modern dates. Is there one to be depended on of an earlier date than "Flamsteed's Catalogue of 1676?" I cannot meet with one.—ALFRED CHAMPNESS.—[Flamsteed's is the earliest reliable catalogue.—ED.]

[168]—THE MOON.—How is the absence of atmosphere and water in the moon accounted for? Lockyer, in his elementary astronomy, says that the dark portions of the moon are old ocean beds, but does not attempt to account for the disappearance of water.—G. P.—[The general belief is that, as the moon's mass has cooled, the water originally forming lunar seas has been withdrawn (soaked up as it were) into the moon's interior, the atmosphere partly following, partly entering into chemical combination with the substances forming the moon's surface. The moon probably shows the condition the earth will have attained in two or three hundred millions of years.—ED.]

[169]—LIGHT AND LANTERN.—Required names of good book or books for the study of "Light" with the use of the lantern.—J. W. STOW.

[170]—SCENTS.—What is a scent? That it is a substance, I suppose, will be generally admitted, for it is blown along by the wind. It has occurred to me that objects which emit scents do, for the most part, lose some of their weight or bulk—that is, the substance shrinks or becomes lighter, and if so it must throw off something in infinitesimally small particles or otherwise, which affect the sense of smell in animals and human kind. Please explain what is known about it.—PRESTER W.

[171]—CHOANITES.—Are the flints, commonly called choanites, "silicified *sponges* from the chalk," or are they petrifactions of a higher kind of animal, an anemone (if, for instance, indeed a sponge can be called an animal at all, which seems to be doubtful with Professor Ansted)? Are sponges, similar in form and arrangement to the flints above named, found in a living state? I have never seen any; on the contrary, living specimens are similar to the sponge of commerce, and to a few only of the petrifactions; exhibiting perpendicular tubes only, not lateral or horizontal, as in choanites. Is the spiral worm round the body or cup of the choanites, a parasite or a part of the intestinal arrangement of the animal itself? I am aware that, if the worm is a parasite, such a conclusion is fatal to the idea of an anemone, for how could a parasite obtain admission into the bodily substance of an animal so organised? And some choanites are found without the worm. Nevertheless I incline to the belief that the choanite is the sea-anemone silicified.—PRESTER W.

[172]—SHORTEST DAY.—Please tell me why the sun rises latest (8h. 9m.) on Dec. 29, and sets earliest (3h. 49m.) on Dec. 12, though the shortest day is Dec. 21; and also rises earliest (3h. 44m.) on June 16, and sets latest (8h. 19m.) on June 26, though the longest day is June 21.—J. E. H. P.—[These and similar anomalies arise from our using the mean sun, not the real sun, to measure civil time. At civil noon the sun's centre is not due south, except on certain days in each year, when the imaginary mean sun and the real sun are together.—ED.]

[173]—Will you tell me, does the electric circuit begin in a battery at the zinc or at the copper plate in the acidulated bath?—[Not known: any more than whether action of sun on a planet begins at the sun or at the planet.—ED.]

[174]—STUDENTS' PHILOSOPHICAL AND SCIENTIFIC SOCIETIES.—I should be much obliged if you could tell me whether there are in London any Students' Philosophical and Scientific Societies, as I should much like to belong to one.—HORACE DAVIES.

[175]—HELIX.—In a recent lecture, Mr. Spottiswoode said, "The curve fulfilling these conditions will be a helix, whose *pitch* is half a right-angle." What measurement is this? In the most ordinary form of helix, viz., a screw, the *pitch* is merely a distance, or, say, a straight line, the space between two threads, measured from apex to apex, parallel to the axis. What is this angle?—COGITO.—[Mr. Spottiswoode was, of course, quite right. The pitch of a helix is an angle, not a distance. It is the complement of the angle at which the curve is inclined to the axis.—ED.]

[176]—BRICK CLAY.—Are the blue streaks in brick clay caused by dissolved sea-weed?—M. WEBB.

[177]—THE NAUTILUS.—Is it known for what use is the gut running through the chambers of the nautilus?—M. WEBB.

[178]—SATELLITES OF JUPITER.—I have seen two of the satellites of Jupiter with my naked eyes; is that an unusual thing?—M. WEBB.—[Exceedingly.—ED.]

[179]—FAURE ACCUMULATOR.—Will you kindly tell me if the *quantity* of electricity that a Faure Accumulator can contain depends upon the size or upon the number of the lead plates? Would one or two large plates contain as much as half-a-dozen small ones?—R. P. H.

[180]—THE POLE.—Kindly state how Arctic explorers will be able to tell exactly when they reach the North Pole. How will they know that they are not some miles wide of the mark?—PILULA. [Astronomical observations showing any given star at same height all round the heavens would give their place near enough.—ED.]

[181]—BEES.—I want to keep bees, and want a list of the best honey-producing flowers to cultivate in my garden. Will you be good enough to tell me where to get this knowledge?—PILULA.

[182]—EVOLUTION.—Will Dr. Andrew Wilson or Mr. Grant Allen kindly let me know what is the probable origin of Evergreens? I have tried hard to think it out for myself, but am unable to see what advantage it is to the plant, unless it be that it gives it an opportunity of spreading while the other plants are at rest, or that the exposure to the cold makes it more hardy, and, therefore, better adapted to carry on the struggle for existence.—PLESIOSAURUS.

[183]—EFFECTS OF EFFLUVIA ON HEALTH.—In our dye works here we use a great quantity of bullock's blood, which comes to us in a highly putrid state; in fact, the smell of it at a distance of several yards from the tanks is overpowering to strangers, and causes one to cough. Is it healthy to work amongst it? This is a question which has often occurred to me, and, naturally, I look to the health of those who work during a whole day with this effluvium continually; but, instead of finding them weakly, and exhibiting symptoms of pulmonary disease, I am astonished to see them grow fat and ruddy, and in many cases persons of known weakly constitutions have improved much in health by being put to work in the dye-house.—J. MACCINSLANE.

[184]—ALMANACS AND CELESTIAL MAPS.—Could you kindly inform me through your "Correspondence Column"—1. Where can I get "Dietrichsen's and Hannay's Astronomical Almanac" [no longer published.—ED.] and "The Nautical Almanac" for 1882, and the price of each (where are they published)? [Murray, price 2s. 6d.—ED.]; 2. The publishers of "Middleton's Celestial Atlas" and of "Gall's Atlas," and the price of each?—W. HARDY.

HE that wyll wryte well in any tongue, muste folowe thys councel of Aristotle, to speake as the common people do, to thinke as wise men do; and so shoulde euery man onderstande hym, and the iudgment of wyse men alowe hym. Many English writers haue not done so, but vsinge straunge wordes as latin, french, and Italian, do make all thinges darke and harde.—ROGER ASCHAM, 1545.

Replies to Queries.

[55]—GREEK FUTURES.—Mr. Ernest J. Wernham points out, in answer to "Castor and Pollux," that the rules for forming Greek futures are given in Matthiæ's Greek Grammar. He kindly makes an extract, but we cannot afford space for grammar rules occupying so much space.—ED.

[105]—PRESERVATION OF FUNGI.—"J. S." may preserve fungi in the following manner:—Take 2 oz. of sul. copper, or blue vitriol, and reduce it to powder, and pour upon it a pint of boiling water, and when cold add half-a-pint of spirits-of-wine; cork it well, and call it "the pickle." To 8 pints of water add 1½ pints of spirits of wine, and call it "the liquor." Be provided with a number of wide-mouthed bottles of different sizes, all well-fitted with corks. The fungi should be left on the table as long as possible, to allow the moisture to evaporate; they should then be placed in the pickle for three hours, or longer if necessary; then place them in the bottles intended for their reception, and fill with the liquor. They should then be well corked and sealed, and arranged in order, with their names in front of the bottles.—J. G. PATTERSON.

[109]—RAILWAY COLLISIONS.—In the worst of these accidents the carriages are "telescoped," the seats of the compartments are driven together, causing fractured legs. To avoid this, draw the legs on to the seat and clasp the knees tightly with the arms. I know of cases where this has been successfully tried.—ENGINEER.

[116]—JOHN BULL.—Dr. Arbuthnot, in his ludicrous "History of Europe," represented an Englishman as a bluff, kind-hearted, bull-headed farmer. The character he called John Bull, and since it has become the national nickname.—J. J. W.

[123]—HIGH FERMENTATION.—In this process, which is the one used in the manufacture of English beer, the yeast rises to the surface of the fermenting liquid; hence its name. It is carried on by running a wort prepared from malt, or from a mixture of malt and other saccharine bodies, into a circular vat, partially covered on top to maintain proper temperature, and to prevent access of excess of air, at about 70° Fahr. Yeast is now added, and, having a plentiful supply of the food necessary for its growth, it soon converts some of the soluble albuminous matter of the malt into protein bodies of its own structure, while at the same time it converts a small portion of the glucose sugar present into the cellulose necessary for the construction of its cells. The mother yeast, while thus reproducing itself, not having sufficient oxygen for its action, decomposes the glucose, changing it into alcohol and carbonic acid gas according to the following equation:—

Glucose.		Alcohol.		Carbonic Acid.
$C_6 H_{12} O_6$	=	$2 C_2 H_5 HO$	+	$2 CO_2$

Small quantities of glycerine, succinic acid, and other products are also formed, and the action continues, unless checked by reduction of temperature, until the whole of the saccharine matter is decomposed. "Low Fermentation." This process commences at about 50° F., and the yeast on reproduction sinks to the bottom of the liquid. It is the process mainly employed on the Continent, and beers so fermented cannot be preserved in warm or temperate weather, unless surrounded by ice. The decomposition of the saccharine matter is the same as in "high fermentation." Stahl, Willis, Liebig, and other writers considered fermentation to be due to the oxidation of complex albuminoid bodies which decompose the saccharine matters present, in order to obtain sufficient oxygen for such oxidation; but, according to Pasteur and the greatest of other modern authorities, it is due to the action of living organisms which fall accidentally into the liquid from the air, or are purposely added, as in the case of adding yeast to wort. The yeast organism is the one which sets up alcoholic fermentation, and the reason why it is artificially supplied to wort is to supersede other fermentations that may be induced by germs of another nature gaining access to the liquid by means of air. The other most common ferment germs are those which set up the lactic and butyric fermentations.—E. M. D.—[Answered in the same sense by T. G. Browne.]

[133]—I observe a correspondent inquiring where he can find the Rev. W. H. Dollinger's papers. If he will read the index to the recent volumes of the *Popular Science Review*, he will find papers by that gentleman on microscopical subjects therein noted. The "Proceedings of the Royal Society" should also give him Mr. Dollinger's papers.—ANDREW WILSON.

[137]—HUMBLE BEES.—I beg leave to state that in December, 1880, at the request of some persons in New Zealand, I shipped eighteen fertile humble bees (*Bombus Lucorum*) by the *John Elder*, one of the Orient line of steamers, to Melbourne, Messrs. F. Green & Co., the owners, kindly instructing their officers to take all needful care of them, and see to their re-shipment in the *Arawata* to New Zealand. From a newspaper (the *Timaru Herald*) sent me, I learn that two out of the eighteen arrived alive, and when released, on the morning of Feb. 5, 1881, flew away briskly to seek, as we may hope, nests in which to multiply and increase, and thus bring about that long-desired work, the fructification of red clover. I may mention that these bees were searched for and sent to me by Mr. Duncan Keir, an intelligent nurseryman at Paisley. I packed them in small boxes, and supplied a little sugar in case they might require food in a warmer latitude; but the great point is if possible to keep them dormant during the voyage, and for this purpose I placed the package under the care of the butcher, to put in his ice-house. It is well known that none other than fertile mothers hybernate. Three other humble queens were sent Jan. 20 of last year by the steamship *Norfolk*, which sailed direct to New Zealand, under precisely similar circumstances, and the supply was obtained from the same source, but no tidings concerning them have yet reached me. The experiment has not been repeated this winter, owing to the very scanty encouragement received of these and previous efforts. Your correspondent, no doubt, alludes to an attempt made some years since by the late Mr. Frank Buckland, in which I had the pleasure of giving some assistance.—ALFRED NEIGHBOUR.

[140]—ICE.—Ice contracts and expands as other solids do, by variation of temperature. This is best seen in travelling over the ice on a large lake (say Lake Winnipeg) in winter. If a cold "snap" suddenly comes on, and the temperature falls 15° or 20° in the course of the night, loud noises, like pistol shots or distant thunder, are heard; if encamped near the shore, on resuming the journey in the morning, large cracks, several feet wide, caused by contraction, will be met with, and are often difficult to cross; if the severe cold continues for a day or two, these cracks freeze up. Milder weather comes, the ice expands, and there being now more ice on the lake than before, ridges are forced up. Another period of great cold occurs, there are fresh cracks formed, with subsequent ridges when the temperature rises. These contractions and expansions, caused by changes of temperature, I believe to be an important element in the motion of glaciers.—J. RAE.

[146]—CHEMICAL.—(1). It is a property of red blood-corpuscles to absorb oxygen. This absorption changes them to bright red. Carbonous oxide can displace O, and thus acts as a poison. Nitrogen has no such power. (2). The value of carbon hydrates as food can only be estimated thus in compounds of the same class; *e.g.*, we cannot compare ether with its 22 per cent. of O, with sugar having 51 per cent., the fact being that sugar, &c., are more assimilable than many substances having less oxygen.—C. T. B.

[146]—CHEMICAL.—E. M. must remember that the "Carbohydrates" are just those bodies which contain the hydrogen and oxygen in the proportion of water—that is, in a saturated condition—none free. Cane sugar, for example, is $C_{12} H_{22} O_{11}$, in which "E. M." will find eleven times H_2O, leaving 12C to answer his purpose.—LEWIS ARUNDEL.

[147]—B.SC. EXAMINATION, EDINBURGH UNIVERSITY.—In reply to "A Philosophical Brushmaker," I may say that attendance upon the University classes necessary for the above degree (or upon classes conducted elsewhere, but recognised by the University Court), is imperative upon candidates. Full information may be obtained in the University *Calendar*.—ANDREW WILSON.

[152]—NICKEL PLATING.—In the first part of "Amateur Work" there is a recipe for this:—Make a bath of tin tartar, boil with some grain tin, and after cooling, throw in some red-hot nickel oxide. When the solution turns green, dip in your articles (brass or copper, of course, and perfectly clean) and in five minutes they will be coated. Though I understand chemistry well, I should be glad to know what tin tartar is.—LEWIS ARUNDEL.

[153]—DOUBTFUL ORGANISMS.—The creatures you allude to are called Protista; they partake equally of the nature of the lowest animals and the lowest plants.—LEWIS ARUNDEL.

[153]—There are certain living beings—if these are what "H. J. C. W." means by "doubtful organisms"—which present in themselves a singular combination of the characters of animals and plants. Such are the Monads. If "H. J. C. W." will read Huxley's lecture on "The Border Territory between the Animal and Plant Kingdoms" (to be published in his new volume of essays, "Science and Culture"—Macmillan), he will find therein a full statement of the likenesses which exist both to animals and plants in certain of the lower forms of life—ANDREW WILSON.

[154]—Frogs are excluded from the class Reptilia (as any ordinary primer of zoology would have shown "H. J. C. W.") because they possess gills in early life. No *reptile* (*i.e.*, tortoises, snakes, lizards, and crocodiles) possesses gills at any period of existence, but breathes from the first by lungs. Frogs, newts, toads, &c., are *amphibians*. They all begin life with gills, and afterwards develop

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lungs; the gills either disappearing when lungs appear (as in the frogs, toads, and newts) or persisting (as in proteus, the axolotl, &c). Frogs and other amphibians further differ from reptiles in undergoing a *metamorphosis* during their development, and in the want of scales or bony plates on the skin.—Andrew Wilson. [I find what "I had always supposed" (viz., that the class Reptilia included the Amphibia, and therefore the Batrachians) is an error. (It was not given, be it noticed, as a reply.) I know, of course, that some naturalists regard the Amphibia and Reptilia as distinct classes; and I see that in Prof. Newton's primer they are so given. I know also that Linnæus's mistake in classing the abranchiate reptiles as amphibia had been corrected. But there must have been some change in classification of late, if that I mentioned has been definitely rejected; for I find Prof. Owen, in "Brande's Dictionary of Science" (1867), writing (1) under head "Reptilia," that those which retain gills during a part of their existence are called Batrachians; (2), under head "Amphibia," calling those which retain their gills during the whole of their existence peribranchiate reptiles; and (3), defining Batrachia as "an order of Reptilia, including all reptiles which, like frogs and toads, have naked skins and external branchiæ in the early stage of existence."—Ed.]

[155]—I have known of a tortoise living ten years; but I should say the duration of life is longer, especially in the larger species. I should imagine they do not remain "under the earth," in ordinary circumstances, longer than the winter or cold season.—Andrew Wilson.

[157]—Aluminium.—Any good Chemistry, as Fownes', or Watts', or Miller's, gives a full account. It is too much to expect in these pages. Spell aluminium with two i's, and emphasize the "min."—Lewis Arundel.

[170].—"E. M.," in Knowledge, for Jan. 6, thinks that the existence of parasites in meat is an argument for vegetarianism. Permit me to remind "E. M." that parasitically-infested meat is not normal meat. If "E. M.," as a vegetarian, acquired a tapeworm guest from a lettuce, he would not abjure his vegetable food, I suppose, because of his liability to infestation therefrom, any more than he would cease drinking water because some waters contain young flukes. The lesson taught by my paper is not the abjuration of flesh as an article of food, but the careful selection of healthy flesh; and, I will add, of healthy and normal food of all kinds—vegetables and drinks included. The *pros* and *cons* of vegetarianism lie quite outside your correspondent's letter and my article.—Andrew Wilson.

[180]—"An Amateur" inquires the "use" of bugs, fleas, flies, and other "apparently useless insects." He should first learn that the word "use" has a sole meaning and application (as he employs it) to human life. He should learn next that each animal and plant exists for its own sake, and independently of any "use" which men may conceive it adapted to serve. Thus "An Amateur" might as legitimately ask the use of seals, and might receive the reply "to furnish sealskin jackets for ladies;" and hummingbirds might similarly be regarded as existing for the purpose of decorating ladies' hats. In a word, science can take no heed of such a question as that put by "An Amateur." Like the Smith of Perth, each animal and plant fights "for its own hand," and lives and exists independently of all human ideas of use and no use.—Andrew Wilson.

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* Knowledge, *the increasing circulation of which compels us to go to press early in the week.*

Hints to Correspondents.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. No queries or replies savouring of the nature of advertisements can be inserted. 4. Letters, queries, and replies are inserted, unless contrary to Rule 3, free of charge. 5. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 6. Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

W. A. C. Mr. Hutton points out that if we cease to eat meat we shall destroy animals more certainly and more cruelly than at present, by leaving them no vegetable food; and he is an anti-vivisectionist of the most pronounced type. We had better not insert your objections to the toad-pressing story, lest boys should try the very experiments you say the story suggests—which certainly would not have occurred to us.—A. St. Clair. We know of no French educational paper whose editor would take English stamps in payment.—W. H. H. Soames. Certainly the moon occults the planets. Such phenomena are announced in the "Nautical Almanac." The outer satellite of Jupiter often passes considerably above or below the planet. In an article we wrote in 1867 for the *Popular Science Review*, we discussed the question fully.—Fred. Blackett. Our price is small, our modesty great; beyond sending specimen copy, we would not force ourselves on your society's notice.—W. R. Bland. The proprietors consider that such notice should appear as an advertisement.—W. H. Pertwee. Arctic explorers want, I suppose, to find what there is at the Pole—land or water, greater cold or less cold, and so forth. As to the other question, evolutionists may or may not believe in the statement you refer to, or some of them may and some may not; it is no business of ours. If you had asked me what I believed on that or kindred subjects, I might have replied that it was no business of yours, which, though it would have sounded abrupt, implies something which may be usefully remembered. A man says he believes a certain scientific fact, and he is asked—without rhyme or reason—whether, so believing, he can believe something else which the inquirer says he and others regard as a truth of religion. What sensible answer can he make to a question so absurd, without being somewhat plain-spoken? To such a question, as to my belief, asked me in public at New York in 1874, I answered, "My belief is that there is a deal of nonsense in the world," and I believe still that I could not have answered the question more precisely, unless for "nonsense" I had used a stronger expression.—Frank R. Thomas. It certainly appears that "the mind is only partially active, and that the sounder part of it—the reason—is dormant when we are dreaming." You ask, "to what does this point?" We are not quite sure that we understand you. It seems to us what might very naturally be expected.—E. H. Thanks for pointing out that Newton, in his work on fluxions, described the Witch of Agnesi, calling it a "conchoidal." We agree with you that the curve cannot properly be called a quadratrix.—F. Wilson. The laws of perspective are purely geometrical, and the slightest acquaintance with geometry would show you that perspective cannot possibly account for the disappearance of a hull of a ship before its masts. The hull is unseen because there is something in the way, namely, the rotundity of the earth.—Wm. H. Allen. Thanks for extract on actinium. Very little is known yet respecting the properties of the new element. Several have been discovered since spectroscopic analysis was invented.—Desideratum. The delay you refer to is explained by the circumstance that we receive so many letters like the one signed "Desideratum."—A. Champness. We cannot reply by letter to queries, even when a stamped and directed envelope is sent.—An Inquirer. If we put in your query about cats falling on their feet, we shall have all our school-boy readers trying experiments—applying the inductive method, with projective illustrations.—Æolus. No; the Americans do *not* (we believe) "fire their storms at us out of a gun." Ships reaching America give news of storms travelling eastward across the Atlantic, which had been already traced across part of the American continent. The prediction is based on the belief that such storms will travel farther east before they die out. You are more correct as to solar heat being the cause of storms; but they may arise without the sun being "in some vagaries." The heat he pours on the earth is tolerably constant.—One who wants Knowledge asks for information respecting the manufacture of Portland cement, or titles of books relating thereto.—E. S. We have not room for your letter on primary colours. If a definition of primary colours were given, which should carefully distinguish what is physical in the matter from what is physiological, we might get more satisfactory statements. As to your questions relating to religion, I reply that to exclude religion, in its wider and nobler sense, from our columns would be to exclude science. But dogmatic religion we cannot away with. One might as reasonably speak of a Mussulman spectroscope, or of Brahminical hydrogen, as of Christian science. Science is neither Christian nor un-Christian, but extra-Christian. We do not want such matters to be treated in a calm, philosophic spirit, but simply left altogether untouched. They have no proper place here. As a mere matter of detail, we may note that they never are treated in a calm, philosophic spirit, perhaps because no calmly philosophic person would be so unwise as to treat of them at all.—Daleth. About comets' nuclei later.—Mercury. For names of Mr. Wallace's books apply to Messrs. Macmillan. They will well repay study. Read also Darwin's "Origin of Species" and "Descent of Man."—Mabel. W. Laing recommends "E. H." to read Dr. J. Reade's "Experimental Outlines for a New Theory of Colours, Light, and Vision," 1818, and W. Crum's "Experimental Inquiry into the Number and Properties of the Primary Colours," 1830 (books entirely out of date); also, if he reads Dutch, N. Folmer's "Alpha van het Alphabet der Kleuren,"

Groningen, 1875. Prof. Ogden Rood's book on "Modern Chromatics" (Kegan, Paul, & Co., price 5s.) is far better worth studying.—ERNEST J. WERNHAM. There are many proofs, and as many disproofs, of the theory that character can be learned from the handwriting. The method has no scientific interest.—B. DONBAVAND. We insert one of your letters, but your last, on the colours of animals, is too long, and we have not time to abridge it. You take three pages of MS. for initial sarcasms against a valued correspondent, who has really shown a very kind desire to explain matters; another to show that "a tank naturalist must be contemptible in all the ins and outs of him"; then *possibly* you come to business. We cannot say—life is too short to get through more of such letters. Stay. We will not at once consign your letter to W.-P. basket, but only the first four pages, keeping the rest for another trial when we have refreshed ourselves with matters more *ad rem*. Understand, you are as free to say in so many words that Prof. Wilson seems angry, as he was to say that a remark of yours seemed to him silly. But we cannot find space for elaborate sarcasms. We want to get at facts, and invite our correspondents to join in the work, not to try who can say the smartest things.—M. E. PENDRED. It would take much more time than we can afford to go through your letter of some score of closely-written pages, scoring out all that is not to the point; and we can only insert what is to the point.—J. H. SYMINGTON. We misunderstood you about the Collie. Excuse us.—H. A. BULLEY. Lunar influence on weather is conceivable, though never shown to be really effective; but planetary influences, or the absurdities called Astro-meteorology, we cannot even discuss here. We must draw the line somewhere.—ZARES. Dr. Ball's experiment, of dropping one of his namesakes on the floor of a railway carriage, has altogether the advantage over yours of firing a bolt from a catapult. How did you test the horizontality of the bolt's flight, and how eliminate effects of atmospheric resistance? We are sure, when we drop a ball in a railway carriage, that its only initial motion is horizontal, and that air-resistances are the same as on a body let fall from rest.—PILULA. You are evidently not aware that advertisements of the kind cannot be refused.—C. J. BROWN. "Assuming the earth's diameter to be 8,000 miles," (or 8, or 8 millions, if preferred,) the pressure is greatest at the centre.—R. W. If the solid be transparent, farther edges should be shown like nearer. The cases are different. Science finds no evidence of man's having become degraded. It does find evidence that some creatures have.—JAS. ELIAS. Your letter is too long for insertion; but your idea is well worth considering, that, in some cases, frog's spawn might have been deposited in some fissure where running water passed, and so a tadpole develope there, which, adapting its mode of living to its narrow surroundings, would become a frog, and might live comfortably enough. A quarryman, as you say, would not be apt to notice the fissure, and the stone would naturally split in a plane running through the cavity.—H. D. KINGDON. Quite impossible to appoint meeting.—DANIEL JACKSON. Gambling on the Stock Exchange is undoubtedly no better than gambling elsewhere. The two books you refer to are the "Expanse of Heaven" and "Infinities Around Us," published by Chatto.—J. K. MELLOR. Thanks, but fear we can find no space for biographies at present.—JAS. DOUGLAS. The change of eccentricity of earth's orbit, and not the precessional reeling *per se*, causes changes of climate you mention.—E. W. Will try to find room for your letter in full. In the meantime, we may note that the applications of the differential calculus to Physics are so much more difficult than those to ordinary mathematical problems, that the course pursued in books seems natural enough. Do you mean to say that, given the linear dimensions of a curve, and the length of the limits between which you integrate, you find difficulty in ascertaining the number of square inches, feet, or miles in the area? I cannot see where the difficulty comes in. In a series of papers I once wrote on the calculus for the *English Mechanic*, I showed how a number of problems in everyday life may be dealt with by means of it. The translation of the symbols into concrete quantities should be one of the first, not one of the last, things to which the student's attention is directed.—A NEW SUBSCRIBER. We shall presently give a description of some comets of the present century; but we must refer you to treatises on comets for an account of all, or even of the principal comets.—PLEIADES. (1). It is better for querists to give their real name (not for publication), but not essential. (2). We may presently give weekly notices of astronomical phenomena. (3). No. 1 of KNOWLEDGE has now been reprinted for the third time; the proprietors are not likely to reprint again, so that if you wish for No. 1 you should apply in good time. (4.) "Abstract" in headings of letters means that we have had to abridge them.—ONE WISHFUL TO LEARN. Heat is not generated at the sun by his attractive action on planets. When a cord is pulled, or a bar either pulled or pushed, the heat is generated by the impressed forces, *i.e.*, comes from without.—E. B. T. Thanks, but the idea is much older than Babbage's time,—R. F. GARDINER than Rev. Mr. Hitchcock's.—W. HARDY. "Dietrichsen's Almanac," no longer published; "Nautical Almanac" for 1882, 1883, 1884, and, probably, 1885, can be obtained of Murray, price 2s. 6d. each.—FLORENCE E. BOYCE. Pray excuse us for leaving your interesting communication so long unnoticed. It got lost in our troubled sea of letters, MS., &c. The proof for sum of squares is very neat.—ARTHUR VIZARD. Your remark answered by last number. But the analysis of chess openings need not be hurried. We must not make a toil of pleasure. Chess and whist are our scientific recreations.—F. H. S. Have been obliged to limit answers to magic square questions.—J. RUSSELL. How far should we be advanced if we agreed to regard comets as having "the same place in the inanimate solar system as is occupied by jelly-fish in the animal world?"—J. SHARP. You article somewhat too diffuse, and much of its contents generally known.—URSULA. Reply to query about rainbow on page 212, second column, lines 11, &c.—LEWIS ARUNDEL. Your remarks about my replies to 153, &c., remind me somewhat of Molière's "*Nous avons changé tout cela.*" I was not answering "according to Cuvier," but according to Owen and other more recent authorities. In explanation of a certain property of worms, I referred to their being articulated. Do you conceive that when worms were formed into a sub-kingdom Vermes, they ceased to be articulated, or that the chain of ganglia I mentioned ceased to be present in their annelidan bodies? They have no articulated limbs, but they are articulated animals whether classed as Arthropoda or Vermes, whether called Abranchiate Annelidans, or common earthworms. Equally, classing toads and frogs as Batrachian Amphibia has not made them change their reptilian habits.—D. C. JONES. Recently answered.—A. T. C. Pardon me for repeating that there must have been something near or far off between the sun and the holes. In saying that the sun's light ceased to pass through the holes (there being nothing between the holes and the opposite wall at the time), you in effect say that something intercepted the sun's rays. If you insist on it that there was nothing between the sun and the blind to cast a shadow—cloud, flight of birds, or of dust, or of leaves, or flying object of some sort, near or far off—all one can say is that nothing can explain what you saw. No shadow ever yet existed without something to cast it.—MAJOR. The illusion about letter S is well known to proof correctors. The lower half looks very much larger upside down.—C. F. B. The reason why the sun and moon appear larger when near the horizon is, I take it, because the heavens appear to form a flattened not a spherical dome, and the sun or moon subtending really the same angle when near the horizon (appreciably) seem to be nearer than the sky beyond. The eye seems to misinterpret what it actually sees, making the sun seem nearer instead of the sky seeming farther.

Notes on Art and Science.

MR. J. H. A. MACDONALD, Q.C., the late Solicitor-General for Scotland, has constructed an "electric holophote course indicator," which he has lately been exhibiting in Edinburgh. An electric light with a reflector is placed in a prominent position on the deck of the vessel, and is controlled by the movement of the helm. The direction of the powerful beam of light indicates the course of the ship, and at the same time shows whether or not the sea is clear over a large area. The model is to be shown at the Crystal Palace Exhibition.

MR. JACOB REESE, in a paper read before the Engineers' Society of Western Pennsylvania, remarks: "The great want of the present age is a process by which the static caloric of carbon may be set free by non-luminous combustion, or, in other words, a process by which coal or oil may be oxidised at a low degree within an insulated vessel." This cannot be too prominently brought forward. "If it can be accomplished," as Mr. Reese says, "we would be able to produce from twelve to fifteen million foot pounds of electricity from one pound of petroleum, or from ten to twelve million foot pounds of energy from one pound of good coal."—*Athenæum.*

ARE BEES A NUISANCE?—An unusual case is being tried in the Cumberland County (Penn.) Court this week, that of testing by a jury whether the keeping of a large number of bees in a town or borough is a public nuisance or not. The case is from West Fair-

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view, a small town on the opposite side of the river from Harrisburg. Two citizens had about 130 skeps of bees, and as the summer was scarce of material such as the bees feed upon, they came in large numbers into the houses, stores, grape arbours, and wherever there was anything for them to feed upon. In one instance they swarmed in a neighbour's kitchen, and were there for days, he not being able to hive them, the queen being killed. They were especially bad about canning and preserving time, compelling the housewife to do her preserving in the evening, and in one instance the wife had to climb in and out of the window for days, not daring to open the doors, for the bees would go in by hundreds; persons were stung passing along the streets and highways; entire houses became infested with bees, so much so that the inmates could not retire to rest at night without being stung by the bees; trays of fruit put out for drying were entirely consumed. Indeed, a reign of terror was experienced for several months, until a committee of citizens agreed to abate the nuisance, and, after several efforts, appealed to the court. The defence claimed that the raising and keeping of bees was an industry, and as such could not come under the head of a public nuisance, and that suit could not be brought nor damages recovered for the keeping of honey-bees. The attorneys on both sides presented the opinions of several judges and the law points in the case, after which the court decided the case should be tried, and the testimony was received. But one case seems to be on record in the State, and that was tried before Judge Pearson, in Dauphin County, years ago, in which the defendant was adjudged guilty, and had to pay a fine and abate the nuisance.—*Scientific American.*

THE TAPE-WORM.—Most of my readers know that the domestic pig is subject to a disease known as "measles," in which the muscles are more or less filled with *cysts*, which render the pork unfit for food; but I think few are acquainted with its cause. Man, it is well known, is occasionally infested by a parasite—the so-called "tape-worm" (*Tænia solium*)—which may be described as having a tape-like body of varying length, with a differentiated "head," or *scolex*, at one extremity. This apparently single animal is in reality a colony of mothers and daughters, the scolex being the parent of all. This "head" is provided with a *rostellum*, or, as it might be called, proboscis, encircled by a crown of hooks, below which are the suckers; each segment added to the scolex is a complete individual containing a complicated and perfect reproductive system. The last segment—*proglottides*—which are filled with eggs, break off at intervals, and either the eggs are set free within the intestine of their host, when they are passed out with the fæces, or the segments themselves are evacuated. The tape worm feeds on the juices of the bowel by absorbing the nutriment through its skin, and does not appear to seriously inconvenience its host in any way. In Abyssinia *tænia helminthosis* is constant and general; indeed the animal is there regarded as a sort of hygienic agent, and cultivated rather than discouraged, yet the people are healthy; certain it is also that wild animals, almost without exception, harbour at least one species of tape-worm as a natural condition. But what has this to do with "measles"? Now to the point. Let us suppose one of the beforementioned eggs taken into the stomach of a pig, either by its eating the excrement of a person affected or through the water or air; here it hatches, not into a tape-worm, but into an animal of oval form, transparent, contractile, in the middle of which are six stylets arranged in pairs; with these it cuts its way through the tissues until the muscles are reached, when, having arrived at its destination, it stops burrowing and surrounds itself with a sheath. Here the stylets atrophy, a new and quite different crown of hooks is produced, and the parasite becomes a *cysticercus*, or vesicular worm, the cyst being about the size of a hazel nut. This constitutes "measles"; the exhaustion or even death attendant on the disease is caused by the scores, hundreds, or even thousands of animals boring through the tissues. Once encysted there is no further suffering or danger. The cysticercus remains encysted for months or years, or until the piece of flesh enveloping it *is introduced into the stomach of man*, in which case it instantly quits its torpid condition, leaves its sheath, makes its way to the intestine, where, attaching itself by its suckers and hooks, it grows—or rather reproduces—so rapidly, that in a few weeks a tape-worm of several yards in length is formed, which reproduces eggs, and so *ad infinitum*—from pig to man, from man to pig. Should the eggs be introduced into man himself or animal other than the hog, the cysticercus penetrates the tissues in the same manner, but it is "not at home," and instead of resting in the muscles, it makes its way to other organs, such as the brain, heart, or eye, where its presence has caused in man several instances of insanity and death. Should a piece of meat containing a vesicular worm be eaten by a pig or animal other than man, a *tænia* is developed, but it also is "not at home," and does not attain its full development. Both eggs and cysticerci are killed by a temperature of 200° Fah., so there is no danger in eating well-cooked pork, even if it contains cysticerci. To prevent hogs contracting "measles," it is only necessary to prevent them having access, either through their food or water, to the secretions of man, and they will not suffer. Throughout the genius *Tænia* we find this dual life; for instance, the cat has a tapeworm, the cysticercus of which she gets from the mouse; and the dog one which he obtains from the sheep.—*Scientific American.*

Our Mathematical Column.

ALGEBRAICAL EQUATION. — In reply to "E. H.," there is no method of solving the equation

$$\sqrt{100-y^2}+\sqrt{8y-64}-6=0$$

other than by reducing it to a cubic, and applying one of the approximate methods to the resulting equation. We get by squaring both sides, &c.,

$$y^4+16y^3-192y^2-3200y+25600=0$$
$$\text{or } y^3(y-8)+24y(y-8)-3200(y-8)=0$$
$$\text{Whence } y=8, \text{ and } y^3+24y-3200=0$$

As "E. H." points out, 9·74 is an approximate root of this equation. The other roots are imaginary.—ED.

[12]—"F. B.," admitting that if $\Sigma_n=\dfrac{2n\,(2n-1)\,\ldots\,(2n+1)}{1\,.\,2\,.\,3\,\ldots\,.n}$,

$$\Sigma_n+1=\Sigma_n\left[\frac{2(2n+1)}{n+1}\right]$$

asks whether we might not at once conclude from this that if

$$S_n=1+{}^2n+\left[\frac{n(n-1)}{1.2}\right]^2+\text{ &c. }+{}^2n+1,$$

and it can be shown that

$$S_n+1=S_n\left[\frac{2(n+1)}{n+1}\right]$$

then $\Sigma_n=S_n$.

We might, if we could prove the relation in question, but we must do this first. How does "F. B." propose to show that when n becomes $n+1$ in the expression for S_n, the result, or S_n+1, is equal to S_n multiplied by $\dfrac{2(2n+1)}{n+1}$? It is easy to infer this after showing that $\Sigma_n=S_n$, but as a step towards proving this it is not at all easy.—ED.

SQUARE AND CUBE NUMBERS.—J. A. Miles sends the following, respecting some curious properties of square and cube numbers:—

The first term of an arithmetical progression of n terms having a common difference d, and whose sum is n^a is equal to

$$n^{a-1}+\frac{d}{2}(1-n).—$$

If $S=n^2$, the first term is $=n+\dfrac{a}{2}\,(1-n)—$

Every square n^2 is the sum of an arithmetical progression of n terms, the first term of which is unity, and the difference 2.

Every square n^2 is the sum of an arithmetical progression of n terms, the first term of which is $\dfrac{n+1}{2}$ and the common difference 1.

If $S=n^3$, the first term is

$$=n^2+\frac{d}{2}(1-n)$$

Every cube n^3 is the sum of an arithmetical progression of n terms, the first term of which is unity, and the common difference $2.(n+1)$.

Every cube n^3 is the sum of an arithmetical progression of n terms, the first term of which is the root n, and the difference $2n$.

Every cube n^3 is the sum of an arithmetical progression of n terms, the first term of which is n^2-n+1, and the difference 2.

Every cube n^3 is the sum of an arithmetical progression of n terms, the first term of which is a triangular number $\dfrac{n^2+n}{2}$, and the difference $=n$.

Every cube n^3 above 1 is the sum of an arithmetical progression of n terms, the first term of which is $(n-2)^2$, and the difference $=8$.

Our Whist Column.

BY "FIVE OF CLUBS."

THE LEAD (*Continued*)

LEADING AN ACE (PLAIN SUITS).

WE omitted to mention one case—quite exceptional—when an Ace is led from Ace, King, and others. This is dealt with in the next section.

LEADING A KING (PLAIN SUITS).

From a long suit, or from a suit of three at least, King is only lead under two conditions, viz :—

(1) From Ace, King, and others.
(2) From King, Queen, and others.

In the case of a forced lead from King and one other, the King is always led.

Here we may answer a question often asked by young players when corrected for leading Ace from Ace, King, and others. What difference can it make, they ask, seeing that both cards are of equal strength? To this they add sometimes that as it is a recognised rule to lead the highest of a sequence (following suit with the lowest) there seems a disadvantage in making what appears like an unnecessary exception.

So far as making the strong cards of your suit is concerned, it is a matter of indifference whether you lead Ace or King. But if you follow the rule of leading King from King, Ace and others, you enable your partner to understand you better. You make your Ace leads more intelligible. If you led Ace uniformly from Ace King, an Ace lead might mean any one of three things; (i.) Ace four or more, (ii.) Ace, Queen, Knave, with or without others, and (iii.) Ace, King, and others. Your partner would often be in doubt which of the three you led from; whereas he can scarcely ever be in doubt which of the two ordinary cases is in question, even though you should be unable to follow up your lead.

As for the lead of King from Ace, King, and others being an exception to the useful general rule, "lead the highest from a sequence," the point is of no importance; for the exception is not one that can ever cause any confusion. In fact, it is becoming a recognised whist principle, that one of the great uses of general rules is that they afford an opportunity for giving your partner information, by departing from them in certain recognised cases. Of this we saw an example last week, in the lead second round from Ace, Queen, Knave, with or without others. After winning with the Ace, the Queen would be the proper lead, if we followed the general rule of leading the highest of a sequence. When the original suit is only of moderate length, (three or four) the Queen is led; but when the suit is of more than average length (five or more) we depart from the rule, and lead Knave second round. Thus, whether we follow the general rule, or depart from it, we give our partner information, yet without in any way affecting the strength of our suit.

There is one case, and one only, in which from Ace, King, and others, Ace should be led :—

If, before getting the lead, we have trumped in one suit, and should then lead King of another suit, our partner, if he had no cards in the suit (a contingency always to be considered) might see an opportunity of establishing a cross ruff or see-saw, by which, perhaps, four or five tricks might be made. He would, therefore, trump your King, considering that Ace might lie with fourth player, and lead the suit which you had trumped. To avoid this, you lead in such a case your Ace first, then your King.

When a King has been led first round, your partner knows from the way the cards fall whether the lead was from Ace, King, and others, or from King, Queen, and others. If you have led from King, Queen, and he does not himself hold Ace, one of the opponents will cover your King with Ace. If it passes, he knows you have Ace. But as a matter of fact, no one at the table remains in doubt about the meaning of a King lead, unless the King is trumped. For if the King makes, Ace follows at once if the lead was from Ace, King; and a small card if the lead was from King, Queen (in which case, of course—the first round having passed—the Ace is with partner).

Thus, just as when the Ace is led, in any case except that of a forced lead, the second round at once shows which of those two suits from which Ace should be led has actually been opened; so is it when a King is led—we can always tell from the second round at latest what suit has been led from—Ace, King, and others, or King, Queen, and others.

There is one exception—very seldom advisable in plain suits—viz., when the King is led from Ace, King, Knave, with or without others. Then leader sometimes changes suit, that he may be led up to and finesse with the Knave.

LEADING QUEEN (PLAIN SUITS).

The Queen is led from a long suit, or from a suit of three, at least, only in the following cases :—

(1) Queen, Knave, ten, with or without small ones.
(2) Queen, Knave, and one small one.

In the case of a forced lead from Queen and one other, the Queen is always led.

After Queen from suit (1), Knave is led, if there is only one card or none below the ten; ten if there are more.

LEADING KNAVE (PLAIN SUITS).

The Knave is led from a long suit, or from a suit of three, at least, only in the following cases :—

(1) Knave, ten, nine, with or without others.
(2) Knave, ten, and one small one.

In the case of a forced lead from Knave and one other, Knave is always led.

After Knave from suit (1), ten is led if there is only one card or none below the nine; nine if there are more.

LEADING TEN (PLAIN SUITS).

Ten is only led in the case of a forced lead from ten one other, or from ten two others.

LEADING A SMALL CARD (PLAIN SUITS).

A small card is led from Ace, two or three small ones (except by continental players, who lead Ace, as already mentioned, from Ace three small ones); from King and others, not including Queen; from Queen, Knave, and small ones (two or more), from Queen or Knave and small ones; from ten and small ones (three at least); from a suit of four small ones, when the lowest is played; and from a suit of fewer than four (a forced lead), when the highest is played. N.B.—From a suit of five cards or more, not headed by the Ace, the lowest but one is played. This lead is called the *Penultimate*.

Our Chess Column.

SOLUTIONS.

PROBLEM No. 5, p. 171.

White.	Black.
1. K. to Q.2.	1. K. takes Kt. (best).
2. R. to Q.Kt.7.	2. Anything.
3. Mates acc.	

PROBLEM No. 6., p. 190.

White.	Black.
1. Q. to K.Kt.5.	1. P. takes Q. (best).
2. Kt. to Q.Kt.5.	2. Anything.
3. B. or Kt. Mates acc.	

PROBLEM No. 7, p. 190.

White.	Black.
1. B. to K.Kt.5.	1. P. takes B.
2. B. to K.B.3.	2. P. moves, or takes Kt.
3. B. or Kt. Mates acc.	

PROBLEM No. 8, p. 190.

White.	Black.
1. B. to Q.Kt.6.	1. P. takes B.
2. B. to Q.B.4.	2. P. moves.
3. B. Mates.	

TWO END GAMES.

THE following end-game has been sent to us by Mr. A. J. Maas. We leave it for awhile as an exercise to our readers. It occurred in actual play :—

PROBLEM, No. 9.

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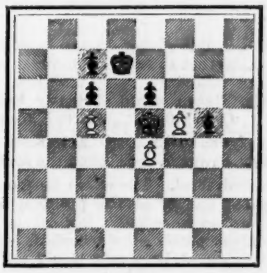

WHITE.

White to play and win.

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In the following end-game, Mr. Morphy (white), who had given the odds of a rook, drew the game :—

PROBLEM No. 10.

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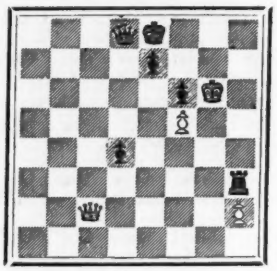

WHITE.

White to play and draw.

GAME No. 6.

Played in the International Tournament at Berlin, on the 15th of September, 1881.

RUY LOPEZ.

WHITE.	BLACK.
Herr S. Winawer.	Dr. C. Schmid.
1. P. to K.4.	P. to K.4.
2. K.t. to K.B.3.	Kt. to Q.B.3.
3. B. to Q.Kt.5.	Kt. to K.B.3. (a)
4. Castles.	Kt. takes K.P.
5. Q. to K.2.	Kt. to Q.3 (b)
6. B. takes Kt.	Q.P. takes B.
7. Q. takes P.ch.	Q. to K.2.
8. Q. to Q.R.5 (c)	B. to K.3.
9. P. to Q.3.	Kt. to B.4. (d)
10. B to B.4. (e)	Castles (f)
11. Q. takes R.P.	Q. to Q.Kt.5.
12. Kt. to K.5 (g)	Black resigns.

(*Sonntagsblatt*, Berlin.)

NOTES BY MEPHISTO.

(a) The defence of P. to Q.R.3. justly deserves preference to the move in the text. It leads to a safe development, for after 4. B. to R.4. Kt. to K.B.3. 5. Castles. Kt. takes P., this Knight, on being attacked, can retire to B.4., attacking the Bishop, and thereby gaining time.

(b) This move must be condemned on principle; it blocks Black's game entirely. Kt. to K.B.3. is the proper move.

(c) This move, which to some might look rather strange, was played to prevent Black from Castling on the Queen's side, as that was his intention; it will be seen that this, though only a small amount of forethought on the part of White, opened the door to a large amount of luck.

(d) As pointed out by the *Sonntagsblatt*, it would not have been feasable for Black to play 9.P. to K.Kt.3 with the intention of preparing to Castle on the King's side, as White would have replied with 10. B. to K.Kt.5 P. to K.B.3. 11. Kt. to Q.4 P. takes B. 12. Kt. takes B. and the Queen cannot retake on account of R. to K.sq. If in reply to 10 B. to K.Kt.5. Black should play Q. to Q.2., then White continues with B. to B.6. Black's best course would have been to play P. to Q.R.3. and then Castle.

(e) Taking proper advantage of the position. The Knight back to Q.3. was about the only thing to save the Pawn, for if P. to Q.Kt.3., then the Pawns on the Queen's side would be weakened still more by Q. to R.4.

(f) The idea of Black in giving up the Rook's Pawn was to play Q. to Q.Kt.5, thinking that the Bishop would be compelled to retire, which Black would follow up by B. to Q.B.4. getting an attack. Checking with the Queen would obviously have been bad, *i.e.*, 11. Q. takes R.P. Q. to Q.Kt.5. 12. Q. to R.8.ch. K. to Q.2. 13. Kt. to K.5.ch. K. to K.sq. and White would lose a piece. Black, however, overlooked the force of 12. Kt. to K.5. at once, which proved fatal. The whole idea of Black of exposing himself to the great danger of the position, for the purpose of extricating his game, was unsound. In chess, as in everything else, you must not indulge in such risky speculations; no move ought to be made but what a sound judgment would approve, as otherwise an unseen danger, or an overlooked resource, is almost sure to aid your adversary in demolishing your unsound speculation; though in many instances, it might be highly ingenious, and, in a few instances, might succeed,—only as an exception to prove the rule.

(g) There is nothing to save Black's game. This is a remarkable collapse of a first-class player, of which there were a good many instances at Berlin. Dr. Schmid played Black, and we apprehend he must have also looked black, after White's 12th move—a rather remarkable instance of a Smith turning into a Blacksmith during a chess game of 12 moves.

Problem No. 11. By Herr Gunsberg.
(From the "Westminster Papers.")

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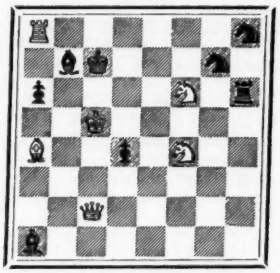

WHITE.

White to play and mate in three moves.

Solutions of problems 6, 7, and 8, by G. W. Middleton, T. H. Symington, J. K. L., Gamma, Try Try Again, S.D.P., R.M., Afternoon, Etoniensis, correct. Of problem 8, by J. A. Miles, Arcadian, and See Saw, correct.

ALPHA BETA.—The solution you send of problem 5 is based on an incorrect idea as to the nature of chess problems. When mate is to be given in three moves, what is meant is, that against the best possible defence White is to give mate on his third move. You have shown how, after a certain move by White, and a certain reply by Black, White can mate. But after White, 1.B. to K.R.3., Black can play Knight to K.R.5.ch., and there is no mate either on the move, or in several more moves.

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NOTICES.

The Publishers beg to announce that in future Monthly Parts of KNOWLEDGE will be issued. The following are now published :—

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